

Thirteen Indicators of the Health of Michigan's Workforce

Original Publication: March 2006
Updated: June 2013

*Michigan Department
of Community Health*



Rick Snyder, Governor
James K. Haveman, Director

MICHIGAN STATE

UNIVERSITY

Thirteen Indicators of the Health of Michigan's Workforce

A Joint Report

of the

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SUMMARY AND RECOMMENDATIONS

This report examines Michigan occupational health trends using nationally-developed indicators. The results can be used to prioritize health conditions for prevention efforts. This report updates the first edition which was published in March 2006.

In 2001, a national panel of experts in occupational disease surveillance developed a set of nineteen occupational health indicators. These indicators are constructs of public health surveillance that define specific measures of health or risk status among specified populations. They can be used to track trends within a state and, in some cases, to compare states to each other or the nation.

The Council of State and Territorial Epidemiologists (CSTE) published a report in 2003 that provides step-by-step instructions for generating state-level indicator data. Subsequently, thirteen states applied these instructions to collect data for one year (2000) and CSTE published the results in an October 2005 report. Since then CSTE has been collecting indicator data annually from collaborating states and compiling them on a website (<http://www.cste.org/?OHIndicators>), as well as updating the instructions.

This step-by-step process was applied to develop trend data for Michigan for thirteen of the nineteen indicators. National trend data were also obtained for comparison for those indicators where these data were available. Data were sought spanning the period 1990-2009. For some indicators, data were unavailable for some years in this timeframe. The salient findings and related recommendations are noted below.

Findings

- Of the thirteen indicators, Michigan rates increased over time only for asbestosis hospitalizations and deaths.
- Michigan rates consistently exceeded national rates for four conditions: non-fatal injuries and illnesses; amputations; carpal tunnel syndrome; and musculoskeletal disorders of the neck, shoulder, and upper extremities. These all were conditions reported by employers.
- Between 1991 and 2002, national hospitalization rates for asbestosis consistently exceeded Michigan's rates. From 2003 to 2009, Michigan's rates exceeded national rates every year except 2004. In 2009, Michigan's rate was more than double the national rate.
- Deaths from or with asbestosis accounted for 25% of all pneumoconiosis deaths in 1990. They comprised 80% in 2009.

Recommendations

Based on these findings, analyses should be conducted to address the following questions:

- Why are asbestosis mortality and morbidity rates increasing in Michigan in recent years while the nation's rates are stable or decreasing?
- Are there particular industries and/or demographic groups that are associated with Michigan's high rates of employer-reported musculoskeletal disorders and amputations?

Results of these analyses may indicate opportunities for targeted interventions to reduce risk (primary prevention) or industries or communities where secondary and tertiary prevention activity such as medical screening or smoking cessation programs should be emphasized.

This report will be updated periodically and made available on the websites of the Michigan Department of Community Health, Division of Environmental Health, and the Michigan State University College of Human Medicine, Occupational and Environmental Medicine Division.

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Introduction

About 4.5 million people work in Michigan. Each year, thousands of these workers are injured on the job or become ill as a result of exposure to health hazards at work. These work-related injuries and illnesses result in substantial human and economic costs for workers, employers, and society at large. Workers' compensation claims alone cost nearly \$1.5 billion in 2009 in Michigan.¹

Work-related injuries and illnesses can be prevented. Successful approaches to making workplaces safer and healthier begin with having the data necessary to understand the problem. Public health surveillance data are needed to determine the magnitude of work-related injuries and illnesses, identify workers at greatest risk, and establish prevention priorities. Data are also necessary to measure the effectiveness of prevention activities, and to identify workplace health and safety problems that need further investigation.

In 2003, the Council of State and Territorial Epidemiologists (CSTE) published a report titled *Occupational Health Indicators: A Guide for Tracking Occupational Health Conditions and Their Determinants*, which details a core set of occupational health indicators identified and developed by a State-Federal Workgroup.² These indicators are a set of surveillance measures that allow states and territories to uniformly define, collect, and report occupational illness, injury, and risk data. They were selected because of their importance to public health and the availability of easily obtainable statewide data in most states. The document provided a step-by-step process for generating individual state indicator data. Then, in October 2005, CSTE published a report – *Putting Data to Work: Occupational Health Indicators from Thirteen Pilot States for 2000* – in which thirteen states applied the step-by-step process to generate one year of data (2000) for each indicator.³ Since then CSTE has collected indicator data annually from collaborating states and compiled them on a website (<http://www.cste.org/?OHIndicators>), as well as updated the instructions.

What is an Occupational Health Indicator?

An occupational health indicator is a specific measure of a work-related disease or injury, or a factor associated with occupational health, such as a workplace exposure, hazard, or intervention, in a specified population. Indicators can be used to track trends in the occupational health status of the working population and identify health conditions that warrant more in-depth investigation.

In this report, the step-by-step process has been applied to develop trend data for Michigan for thirteen of the twenty indicators described in the CSTE reports. The thirteen indicators presented here pertain to health outcomes or hazard exposure (six of the remaining seven are measures of hazard or intervention; the seventh was added in 2009). National trend data are also presented for comparison for those indicators where these data are available. For each indicator, data was sought from 1990 until the most recent year available. Due to differences in data sources, the timeframes covered vary by indicator.

The report begins with demographic profiles of the state and national workforce. A description of the data sources used to generate the indicators, including significant data limitations, is provided in Appendix B. Data tables for each of the indicators are provided in Appendix A.

Employment Demographics

The national workforce has become more diverse. This diversity in age, race, ethnicity, and levels of employment in certain industries and occupations varies across the country. Differences in characteristics of Michigan workers and the United States workforce are important to consider when comparing health outcomes of the state to the nation.

Table 1 presents characteristics of the working population in Michigan and the U.S. in 2009. Michigan had a higher unemployment rate (13.3%) compared to the nation (9.3%). While most of the demographic characteristics were similar, individuals of Hispanic ethnicity comprised a lower proportion of Michigan workers (2.7% vs. 14.0%). Michigan had a greater proportion of workers employed part-time (24.6% vs. 19.5%). Michigan residents worked fewer hours per week than the nation (higher proportion working less than 40 hours a week and smaller proportion working more than 40 hours a week). One in sixteen workers (6.1%) in Michigan was self-employed in 2009. Neither Michigan's workers' compensation system nor the national surveillance system based on the U.S. Bureau of Labor Statistics (BLS) Annual Survey covers incidents of work-related injury and illness among the self-employed.

TABLE 1
Workforce Characteristics, Ages 16 and Older,
Michigan and United States, 2009

Characteristic	Michigan	United States
Number employed (in thousands)	4,253	139,877
% Workforce unemployed	13.3	9.3
% Male	51.5	52.7
% Female	48.5	47.3
% Ages 16-17	1.4	1.2
% Ages 18-64	94.7	94.4
% Ages 65 and older	3.9	4.4
% White	84.2	82.2
% Black	10.5	10.7
% Other	5.3	7.0
% Hispanic ethnicity	2.7	14.0
% Self-employed	6.1	7.0
% Employed part-time*	24.6	19.5
% Work < 40 hrs/week	42.4	35.4
% Work 40 hrs/week	36.0	40.6
% Work > 40 hrs/week	21.5	24.0

* "Employed part-time" are individuals who work 1 to 34 hours per week.

Data Sources: Michigan – Current Population Survey (age distribution only) and Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Table 2 provides the distribution of the Michigan and national workforce by major industry classifications (North American Industry Classification System (NAICS) – based categories). The three primary industries in 2009 were education/health services, manufacturing, and wholesale/retail trade. The largest difference between the Michigan and national workforces was the proportion of workers in the manufacturing industry (14.5% in Michigan; 9.8% U.S.). Note that in 2003, 21.1% of Michigan’s workforce was in the manufacturing industry. Farms with fewer than eleven employees and federal employees are excluded from the BLS Annual Survey.

TABLE 2
Distribution of Workforce by Major Industry Groups
Michigan and United States, 2009 Annual Averages

Industry	Michigan	United States
Number Employed (in thousands)	4,253	139,877
% Mining	0.2	0.5
% Construction	5.4	6.9
% Manufacturing	14.5	9.8
% Wholesale and retail trade	13.5	14.1
% Transportation and utilities	4.4	5.2
% Information	1.7	2.3
% Financial activities	5.8	6.9
% Professional and business services	9.6	10.7
% Education and health services	25.3	22.7
% Leisure and hospitality	8.8	9.1
% Other services	6.0	5.0
% Public administration	3.6	4.9
% Agriculture	1.3	1.5

Data Sources: Michigan – Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Table 3 illustrates the distribution of state and national workers by major occupation classifications (according to the 2002 Census occupational classification system). The two distributions were very similar.

TABLE 3
Distribution of Workforce by Major Occupation Groups
Michigan and United States, 2009 Annual Averages

Occupation	Michigan	United States
Number Employed (in thousands)	4,253	139,877
% Management, business and financial operations	14.0	15.4
% Professional and related occupations	23.5	21.9
% Service	18.6	17.6
% Sales and related occupations	10.5	11.2
% Office and administrative support	12.8	13.0
% Farming, fishing, and forestry	0.6	0.7
% Construction and extraction	4.2	5.3
% Installation, maintenance, and repair	3.6	3.5
% Production	6.5	5.5
% Transportation and material moving	5.9	5.9

Data Sources: Michigan – Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Indicator 1: Non-fatal Injuries and Illnesses Reported by Employers

Work-related injuries are generally defined as injuries that result from single events such as falls, being struck or crushed by objects, electric shocks, or assaults. Work-related illnesses, such as asthma, silicosis, and carpal tunnel syndrome, typically occur as the result of longer-term exposure to hazardous chemicals, physical hazards (e.g., radiation, noise), or repeated stress or strain at work. Infectious diseases also can be caused by workplace exposures. Work-related illnesses are more difficult to track than acute injuries because many illnesses are multifactorial and can also be caused or aggravated by non-occupational factors. In addition, many work-related illnesses take a long time to develop and may not appear until many years after individuals have left employment.

The Bureau of Labor Statistics (BLS) Annual Survey of Occupational Injuries and Illnesses (Annual Survey) provides yearly estimates of the numbers and incidence rates of work-related injuries and illnesses at national and state levels. Information is collected from a nationwide sample of employers on all work-related injuries and illnesses that result in death, lost work time, medical treatment other than first aid, loss of consciousness, restriction of work activity, or transfer to another job.

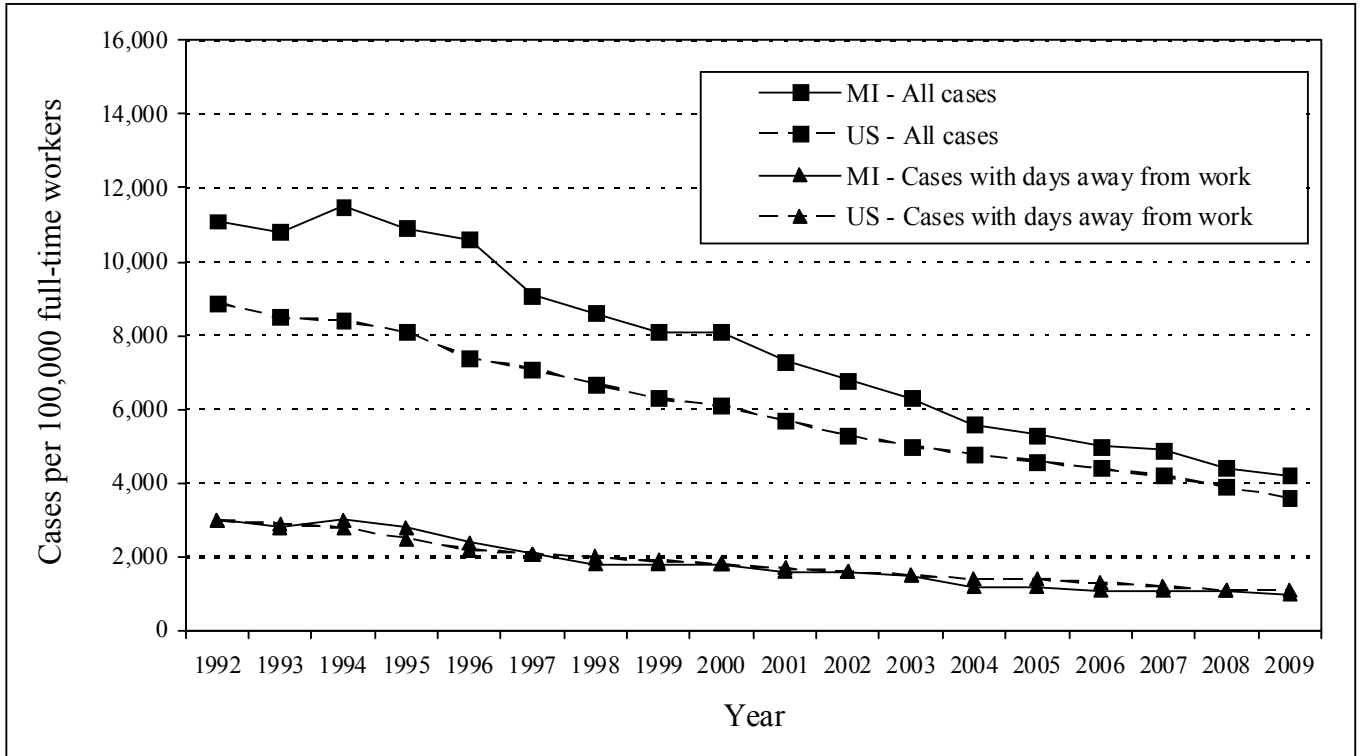
While the Annual Survey is a valuable source of information about work-related injuries and illnesses, it is well recognized that it has a number of limitations and underestimates the full extent of the problem. Public sector workers such as firefighters and police were excluded from national estimates prior to 2008. Self-employed, household workers, and workers on farms with fewer than eleven employees continue to be excluded. Together these sectors comprise approximately 21% of the U.S. workforce.⁴ Occupational diseases are not well documented in the Annual Survey and there is evidence that injuries are underreported.^{5,6} It is also subject to sampling error. Additional data sources used in generating other Occupational Health Indicators in this report provide important supplementary information for a more complete picture of occupational health.

Figure 1 illustrates rates of non-fatal injuries and illnesses for Michigan and the United States for the period 1992-2009 according to BLS Annual Survey data. Michigan's rates for all cases consistently exceeded national rates during this period although the gap has been narrowing. In contrast, there has been little difference between Michigan and national rates for cases involving days away from work.

Rates of reported injuries and illnesses declined during 1992-2009. For all cases, the rate decreased 62% in Michigan (from 11,100 to 4,200 cases per 100,000 full-time workers) and 60% nationally. For cases involving days away from work, the rate decreased by 67% in Michigan and 63% nationally.

The number of cases in Michigan and the U.S. are presented in Table 1.A of Appendix A. Included in this table is the number of cases resulting in more than ten days away from work. In Michigan during 1992-2009, 10% of cases resulted in more than ten lost workdays. Table 1.B of the Appendix contains rates for all cases and cases resulting in days away from work (note: BLS does not publish rates pertaining to cases with ten or more lost workdays.)

FIGURE 1
Rates of non-fatal work-related injuries and illnesses
reported by private sector employers, Michigan and United States, 1992-2009



Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

- The rates published by BLS are the number of injury and illness cases per 100 full-time workers. The rates illustrated here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 1,000. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

Indicator 2: Work-related Hospitalizations

Individuals hospitalized for work-related injuries and illnesses have some of the most serious and costly adverse work-related health conditions. It has been estimated that, nationwide, approximately three percent of workplace injuries and illnesses result in hospitalizations, and that hospital charges for work-related conditions exceed \$3 billion annually. Most work-related hospitalizations are for treatment of musculoskeletal disorders and acute injuries.⁷

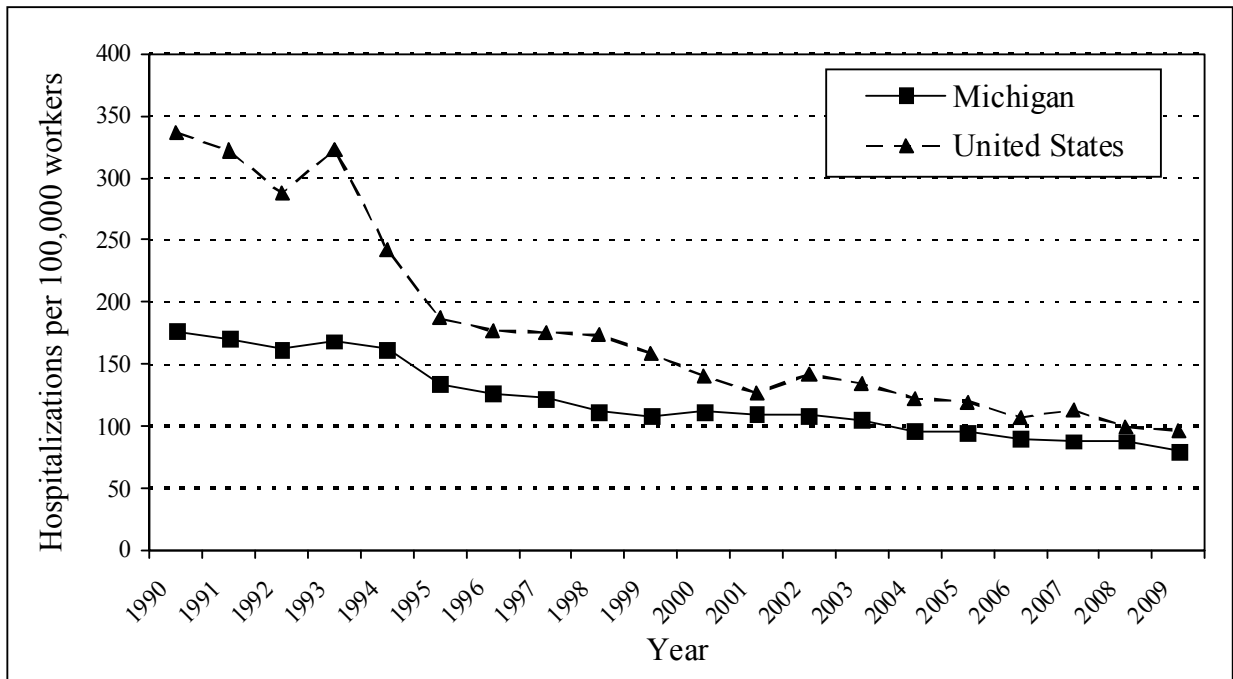
Hospital discharge data are useful for surveillance of certain health conditions. While these data sets do not include explicit information about work-relatedness of the health conditions for which a patient is hospitalized, they do include information about the payer for the hospital stay. The designation of workers' compensation as primary payer is a good proxy for the work-relatedness of hospitalized injuries.⁸ It is not a useful measure of hospitalizations for work-related illnesses.

Figure 2 illustrates hospitalization rates by year for individuals with workers' compensation reported as the primary payer for Michigan and the United States during 1990-2009. For the entire period, national rates exceeded Michigan rates although the difference diminished dramatically starting in 1995. Michigan's rate decreased 55% from 1990 to 2009 (from 176.5 to 80.3 hospitalizations per 100,000 workers). Table 2 in Appendix A provides the numbers and rates for Michigan and the U.S. for the 20-year period.

The sources of state and national data have important differences:

- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the National Hospital Discharge Survey. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.
- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations. For example, in 2009, 3.1% of all Michigan resident work-related hospitalizations, as defined here, were at out-of-state hospitals.
- In 1996, the National Hospital Discharge Survey no longer “re-ordered” principal and additional sources of payment. (Re-ordering is the process by which a source originally listed as secondary is considered the primary payer.) This change could alter estimates causing a difference between pre- and post-1996 estimates of work-related hospitalizations (which rely on using workers' compensation as payer source to find cases). The change would tend to decrease the number of cases identified as work-related (the degree of this reduction is unknown). Ascertainment of Michigan cases was consistent across the time period (only cases where workers' compensation was listed as the primary payer were included).
- There are substantial differences among states in workers' compensation eligibility, reimbursement, and other administrative policies. Thus, differences between Michigan and the U.S. in work-related hospitalization rates as defined in this indicator reflect variations in both workers' compensation systems and the incidence of work-related injuries and illnesses resulting in hospitalization.

FIGURE 2
 Rate of work-related hospitalizations
 Michigan and United States, 1990-2009



Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Employment statistics used to calculate rates: Michigan – BLS Geographic Profile of Employment and Unemployment; United States – BLS Employment and Earnings.

Technical Notes:

- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- Some workers are hospitalized more than once for injuries or illnesses related to a given incident or exposure. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalization incidence, not injury/illness incidence.

Indicator 3: Fatal Work-related Injuries

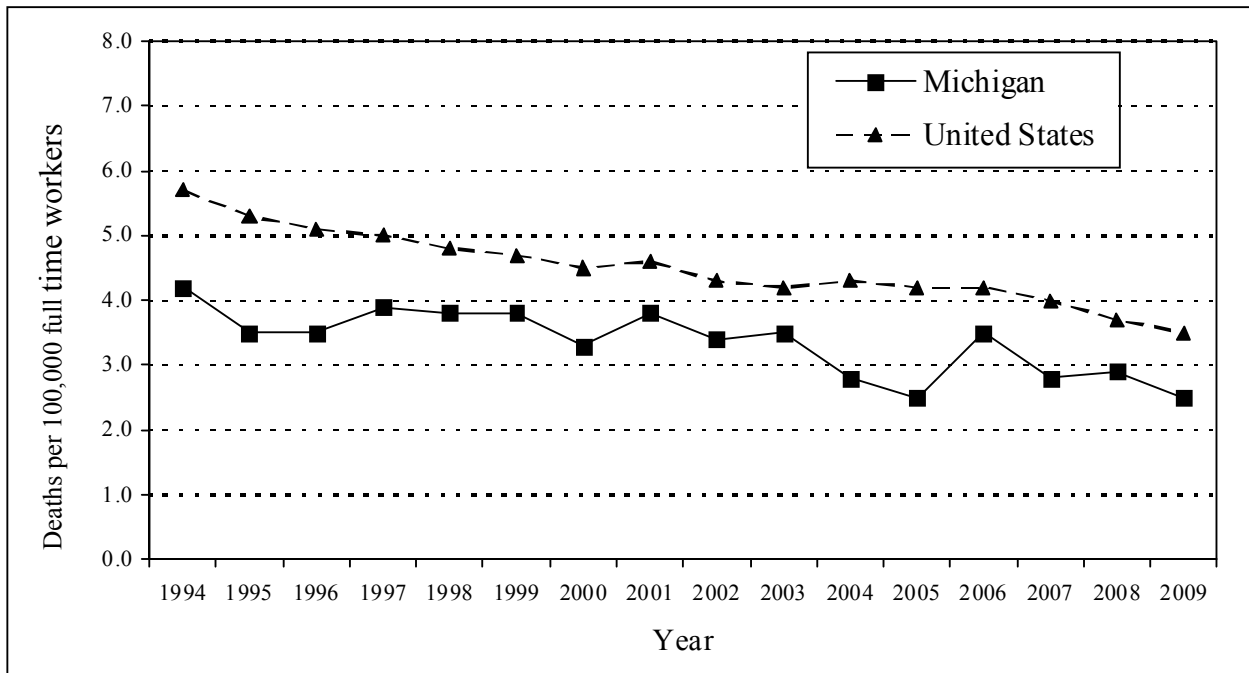
A fatal work-related injury is an injury occurring at work that results in death. The Bureau of Labor Statistics (BLS) conducts the Census of Fatal Occupational Injuries (CFOI), using multiple data sources to provide complete counts of all fatal work-related injuries in the nation and in every state. CFOI includes fatalities resulting from unintentional injuries such as falls, electrocutions, acute poisonings, and motor vehicle crashes that occurred during travel for work. It counts the death in the state where the event occurred, not where the death occurred. Also included are intentional injuries (i.e., homicides and suicides) that occurred at work. Fatalities that occur during a person's commute to or from work are not counted.

Between 1994 and 2009, the national rate consistently exceeded the Michigan rate. Both rates decreased over the sixteen-year period (Michigan by 40%; U.S. by 39%) (Figure 3). Table 3 in Appendix A provides the numbers and rates of deaths each year for the U.S. and Michigan.

Michigan Fatality Assessment and Control Evaluation (FACE) Program

Nine states, including Michigan, have active programs to investigate acute work-related traumatic fatalities. Reports on individual deaths that were investigated and annual reports summarizing Michigan's data from 2001 through 2011 are available at: http://www.oem.msu.edu/MiFACE_Program.aspx.

FIGURE 3
Rate of fatal work-related injuries
Michigan and United States, 1994-2009



Data sources: Numbers of fatalities: Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries.
Employment statistics used to calculate rates: BLS Current Population Survey.

Technical Notes:

- The population data used to calculate rates are Michigan residents while the count of cases includes out-of-state residents fatally injured in Michigan and excludes Michigan residents fatally injured out of state. Thus, Michigan rates may not represent the true resident death rate.
- Workers younger than age 16 and the military are included in the numerators of rates, whereas the employment statistics used to calculate rates excluded these groups. This may result in a slight overestimation of rates.
- The rates listed here may differ slightly from those published by BLS for the following reasons: BLS excludes those under age 16 and the military in calculating state rates; BLS excludes deaths of workers under age 16 and the military in both the numerator and denominator in calculating national rates.

Indicator 4: Work-related Amputations with Days Away from Work Reported by Employers

An amputation is defined as full or partial loss of a protruding body part – an arm, hand, finger, leg, foot, toe, ear, or nose. This injury may greatly reduce a worker’s job skills and earning potential as well as significantly affect general quality of life.

The Bureau of Labor Statistics (BLS) Annual Survey of Occupational Injuries and Illnesses (Annual Survey) provides yearly state and national estimates of the numbers and incidence rates of work-related amputations that involve at least one day away from work. According to the Annual Survey, nationally in 2009 there were 5,930 workers in private industry who sustained amputations that resulted in days lost from work. Ninety-six percent (96%) of these amputations involved fingers. Amputations resulted in an average (median) of 21 lost work days, far exceeding the average of eight lost work days for all work-related injuries and illnesses.

Figure 4 illustrates the estimated rates of reported work-related amputations in private industry for Michigan and the United States for the period 1992-2009. For a majority of these years, Michigan’s rates exceeded national rates. National rates decreased fairly consistently and overall the reduction between 1992 and 2009 was 56%. Michigan’s rates also decreased (by 57%) although they were much more erratic year to year. The estimated numbers and rates are provided in Table 4 in Appendix A.

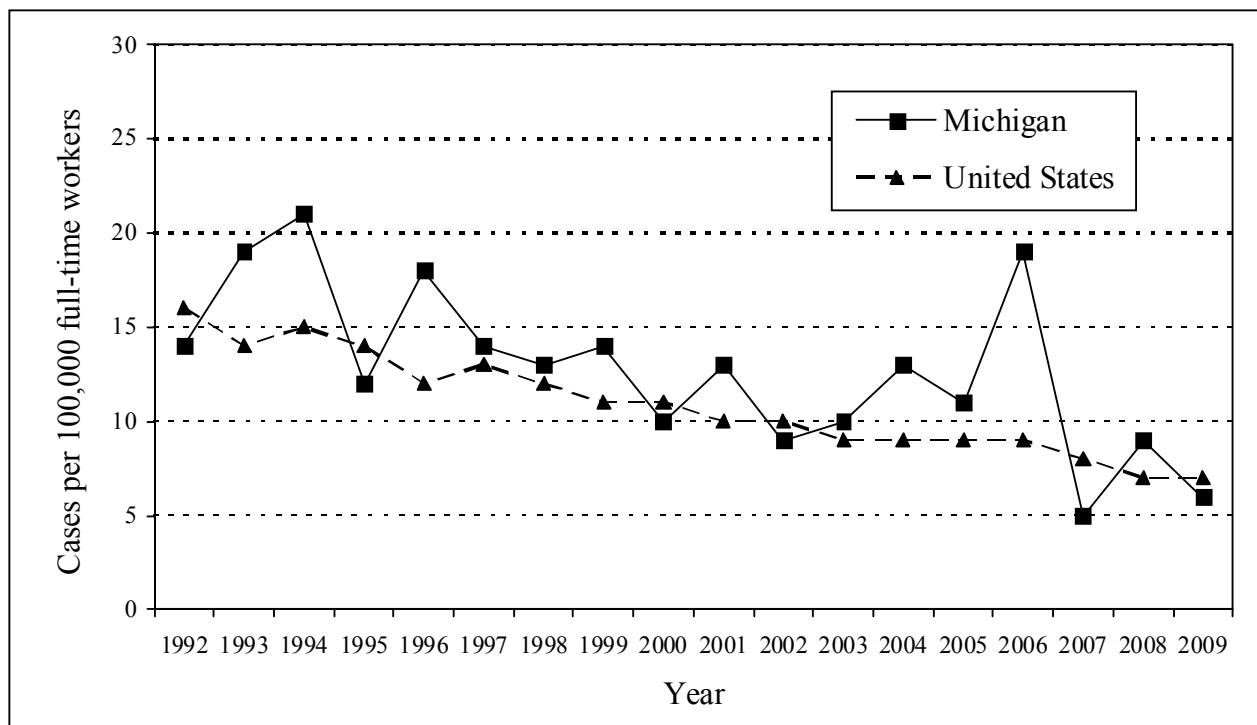
While the Annual Survey is a valuable source of information about work-related injuries, it has a number of limitations. Excluded from national estimates are the self-employed, household workers, and workers on farms with fewer than eleven employees. Together, these sectors comprise approximately 21% of the U.S. workforce.⁴ A study in Michigan found that the Annual Survey identified only 64% of all work-related amputations in 2009.⁹ State workers’ compensation data used in Indicator 5 are another source of information about work-related amputations.

Michigan’s Work-related Amputation Surveillance System

Five states, including Michigan, have active programs for amputation surveillance that utilize multiple data sources. In Michigan, these sources are hospital medical records and workers’ compensation claims. Michigan’s surveillance system confirmed 2,548 state residents who sustained work-related amputations between 2006 and 2009. Annual reports summarizing Michigan’s data for 2006-2009 are available at:

<http://www.oem.msu.edu/AnnualReports.aspx>.

FIGURE 4
 Rate of nonfatal work-related amputations with days away from work
 reported by private sector employers, Michigan and United States, 1992-2009



Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

The rates published by BLS are the number of injury and illness cases per 10,000 full-time workers. The rates presented here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

Indicator 5: Amputations Identified in the Workers' Compensation System

Michigan workers' compensation claims were used as another source of data on work-related amputations, in addition to the estimates provided by the BLS Annual Survey (Indicator 4). Cases were limited to claims resulting in wage compensation. These are claims involving specific losses (i.e., amputation of hands, arms, feet, legs, or, for fingers and toes, loss of at least one phalanx) or amputations resulting in a disability for more than seven consecutive days (e.g., loss of fingertip, but not entire phalanx).

The first year of available Michigan workers' compensation data was 1997. Figure 5A illustrates annual rates of amputation claims for the period 1997-2009 (results for 2004 and 2005 were unavailable due to an irretrievable loss of data for those years). There are no national data on workers' compensation claims to use as a comparison. Table 5 in Appendix A contains the annual numbers and rates. Amputation rates declined fairly consistently between 1997 and 2009. The rate in 2009 represented a decrease of 73% from the 1997 rate.

Workers' compensation claims records do not identify all work-related amputations. The Michigan work-related amputation surveillance system (see description on page 11) utilizes hospital medical records in conjunction with workers' compensation claims data. In 2009, the system identified 491 Michigan resident work-related amputations⁹ – three-and-a-half times as many as workers' compensation claims alone (N=142). While most employees in Michigan are covered by workers' compensation, some are not (e.g., the self-employed, workers on certain small farms). Some workers who are covered may not utilize the system. They may be unaware that their injury was eligible for workers' compensation or they may feel pressure not to submit a claim.

Comparison to Indicator 4

The average annual number of amputations identified via workers' compensation claims was 13% greater than the average annual number identified via employer reports (Indicator 4) between 1997 and 2009* (378 and 336, respectively). Some of this difference is likely due to differences in case definitions. First, the BLS estimate represents private industry only whereas workers' compensation data also include state and local government workers. Second, BLS requires at least one day lost from work while workers' compensation has no requirement on the amount of work lost for certain amputations.

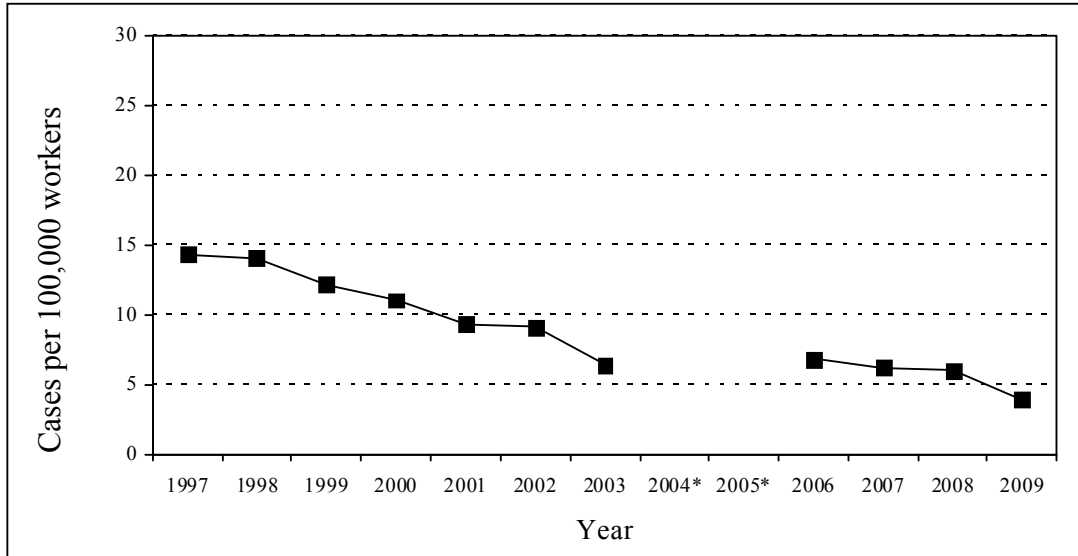
Comparing the two sources in terms of rates actually yields a different result: the average annual rate per BLS during this period exceeded the corresponding workers' compensation rate by 23% (11.1 vs. 9.0, respectively). This apparent paradox is due to differences in the denominators used in the rate calculations. In short, the BLS produces rates based on full time equivalents, not simply the average number employed. Also, as noted above, the BLS rate represents private industry only. For both these reasons, the denominator used in the rate calculation is smaller for than workers' compensation.

According to both data sources, work-related amputation rates decreased over this time period. This decline was more consistent per workers' compensation than BLS, with the latter exhibiting an anomalous increase in 2006 that was not apparent per workers' compensation data. The

* The comparison excludes data for the years 2004 and 2005.

Michigan work-related amputation surveillance system also found that rates decreased between 2006 and 2009, as illustrated in Figure 5B.^{9,10,11,12}

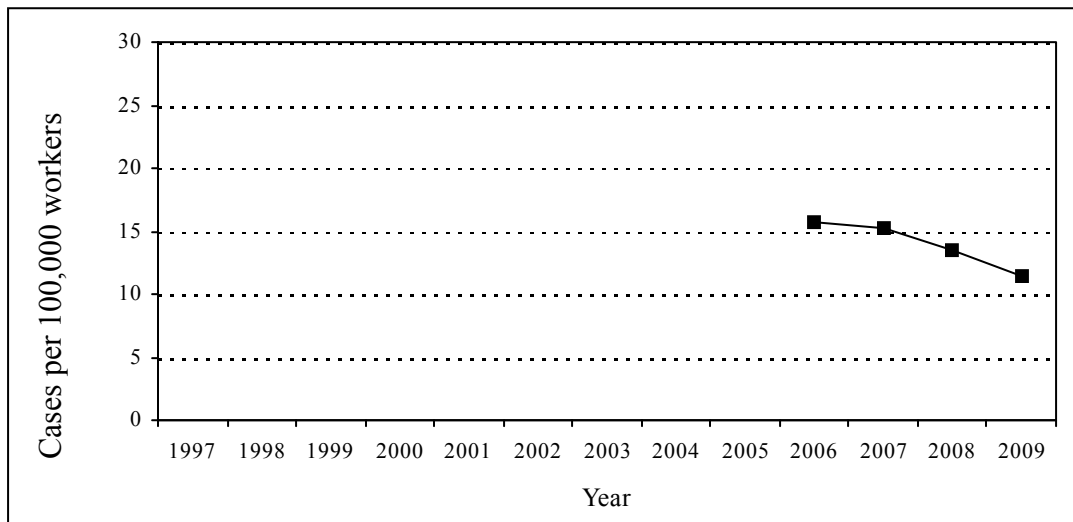
FIGURE 5A
Rate of lost wage claims for amputations identified in Michigan's workers' compensation system, 1997-2009



* Data not available. In April 2005, the Workers' Compensation Agency in the Department of Licensing and Regulatory Affairs sustained a massive loss of workers' compensation claims data without proper backup. Thus, data for 2004 were unavailable when requested in August 2005. A substantial portion of 2005 data were also lost and therefore are not included in the figure.

Data sources: Numbers of amputations: Michigan Department of Labor and Economic Growth, Workers' Compensation Agency. Numbers of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

FIGURE 5B
Work-related amputation rates, Michigan residents, 2006-2009



Data sources: Numbers of amputations: Michigan Department of Labor and Economic Growth, Workers' Compensation Agency and Michigan hospital/emergency department medical records. Employment statistics used to calculate rates: Bureau of Labor Statistics Current Population Survey.

Indicator 6: Hospitalizations for Work-Related Burns

Burns encompass injuries to tissues caused by contact with dry heat (fire), moist heat (steam), chemicals, electricity, friction, or radiation. Burns are among the most expensive work-related injuries to treat and can result in significant disability. Thermal and chemical burns are the most frequent types of work-related burn injury. A substantial proportion of burns occurs in the service industry, especially in food service, often disproportionately affecting working adolescents.^{13,14}

According to the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses, in the United States in 2009, there were an estimated 20,520 burn injuries resulting in days away from work (private sector), for an incidence rate of 2.3 per 10,000 full-time workers. Approximately 30% to 40% of hospitalizations for burns among adults have been found to be work-related.¹⁴

Hospital discharge data are useful for surveillance of work-related burns. While these data sets do not include explicit information about work-relatedness of incidents, they do include information about the payer for the hospital stay. The designation of workers' compensation as primary payer identifies approximately 65% of hospitalized burns.¹⁵

Figure 6 shows burn hospitalization rates by year for individuals with workers' compensation reported as the primary payer for Michigan and the United States during 1990-2009 (national rates are not presented for six years in which the National Center for Health Statistics – the source of the data – deemed the estimates too statistically unstable for publication). For the entire period, national rates exceeded Michigan rates. The Michigan rate decreased from 3.7 to 1.3 hospitalizations per 100,000 workers, a 65% reduction over the 20-year period. Most of this decrease occurred between 1990 and 1998. Although the national rates are erratic from year to year, their overall pattern is similar to Michigan's. Table 6 in Appendix A provides the numbers and rates for Michigan and the U.S. for the 20-year period.

Hospitalizations represent a small portion of individuals who sustain a work-related burn. The Michigan work-related burn surveillance system ascertains cases via hospital medical records for emergency department visits and inpatient stays, the Michigan Poison Control Center, the Michigan Fatality Assessment and Control Evaluation program and workers' compensation claims data. In 2009, the system identified 1,461 MI resident work-related burns,¹⁵ whereas only 57 burns were identified in hospital discharge data.

The sources of state and national data have differences which may limit their comparability:

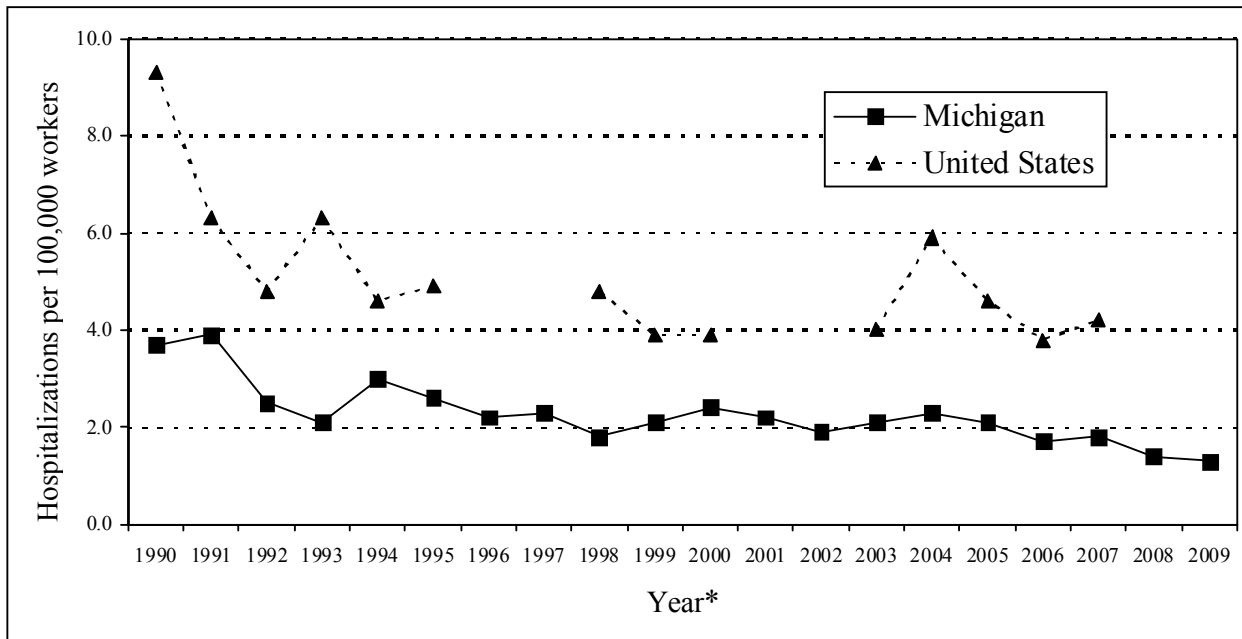
- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the National Hospital Discharge Survey. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.
- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations: an examination of work-related injury hospitalizations for several of the years during this time period indicates that about two percent of state residents are hospitalized out-of-state.

- In 1996, the National Hospital Discharge Survey no longer “re-ordered” principal and additional sources of payment. (Re-ordering is the process by which a source originally listed as secondary is considered the primary payer.) This change could alter estimates causing a difference between pre- and post-1996 estimates of work-related hospitalizations (which rely on using workers’ compensation as payer source to find cases). The change would tend to decrease the number of cases identified as work-related (the degree of this reduction is unknown). Ascertainment of Michigan cases was consistent across the time period (only cases where workers’ compensation was listed as the primary payer were included).
- There are substantial differences among states in workers’ compensation eligibility, reimbursement, and other administrative policies. Thus, differences between Michigan and the U.S. in work-related hospitalization rates as defined in this indicator reflect variations in both workers’ compensation systems and the incidence of work-related injuries and illnesses resulting in hospitalization.

Michigan’s Work-related Burn Surveillance System

Four states, including Michigan, have active programs for burn surveillance that utilize multiple data sources. Michigan confirmed 1,461 individuals with work-related burns in 2009. Hospitals are one of several data sources used in this system. The annual report summarizing Michigan’s data for 2009 is available at:
<http://www.oem.msu.edu/AnnualReports.aspx>.

FIGURE 6
 Rate of hospitalizations for work-related burns
 Michigan and United States, 1990-2009



* National estimate not presented for 1996, 1997, 2001, 2002, 2008, 2009 due to statistical instability.

Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Employment statistics used to calculate rates: Michigan – BLS Geographic Profile of Employment and Unemployment; United States – BLS Employment and Earnings.

Technical Notes:

- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- A burn hospitalization is defined as a hospital discharge with a principal diagnosis in the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)³⁹ code range 940-949.
- Some workers are hospitalized more than once for injuries related to a given incident. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalizations, not burn injuries.

Indicator 7: Musculoskeletal Disorders Reported by Employers

Work-related musculoskeletal disorders (MSDs) are injuries or disorders of muscles, tendons, nerves, ligaments, joints, or spinal discs that are caused or aggravated by work activities. Workplace risk factors for MSDs include repetitive forceful motions, awkward postures, use of vibrating tools or equipment, and manual handling of heavy, awkward loads.

This occupational health indicator is based on data collected by the Bureau of Labor Statistics (BLS) in the Annual Survey of Occupational Injuries and Illnesses (Annual Survey). The BLS definition of MSDs includes sprains, strains, pain, hurt back, carpal tunnel syndrome, and hernia in which the event leading to the condition is reported as overexertion, repetitive motion, or bending, reaching, twisting, climbing, or crawling. The definition excludes MSDs reportedly caused by single events such as slips and falls, and motor vehicle crashes.

MSDs can significantly impact the ability of workers to perform their jobs and affect the quality of life off the job. They are also some of the most common and costly work-related health conditions. The BLS estimated that nationally in 2009 there were about 284,000 work-related MSDs resulting in days away from work (private sector) or 29% of the total number of injury and illnesses cases. It has been estimated that one-third of workers' compensation costs are due to MSDs,¹⁶ thus, of the total \$58 billion workers' compensation benefits paid out in 2009 nationally,¹ about \$19 billion would have been for MSDs.

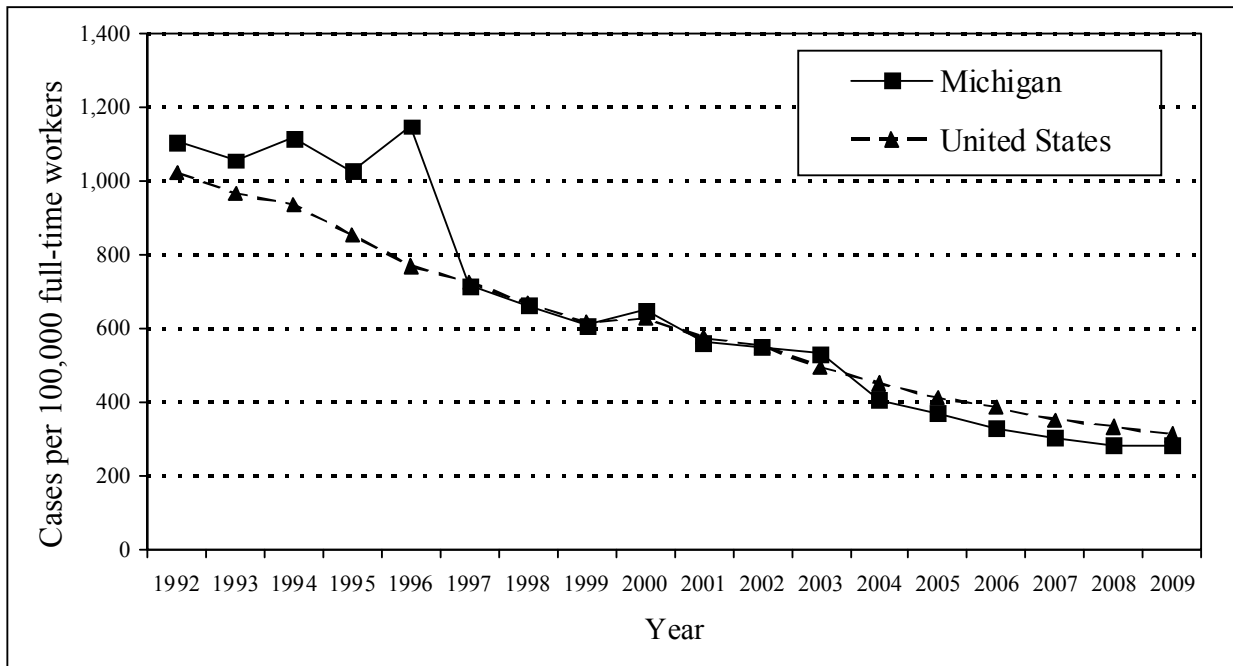
Figure 7.A illustrates the estimated rates of all work-related MSDs resulting in days away from work for Michigan and the U.S. during 1992-2009. Rates decreased substantially over this time period. In Michigan, the rate dropped 75% from 1,107 to 282 cases per 100,000 full-time workers. Between 1992 and 1996, Michigan rates exceeded national rates; thereafter, the rates were very similar.

Figure 7.B illustrates the estimated rates of one form of MSD, carpal tunnel syndrome. As with overall MSDs, rates decreased over time (by 77% in Michigan from 1992 to 2009). In contrast to what was found for all MSDs, Michigan rates exceeded national rates throughout the entire eighteen-year period although to a lesser degree after 2003. Workers' compensation data used in Indicator 8 in this report provide additional information about carpal tunnel syndrome.

Tables 7.A through 7.D in Appendix A illustrate numbers and rates for all MSDs and selected types (neck, shoulder, and upper extremity; carpal tunnel syndrome; and back) for Michigan and the U.S. for 1992-2009. For most years, MSDs of the back account for about half of the total MSDs reported.

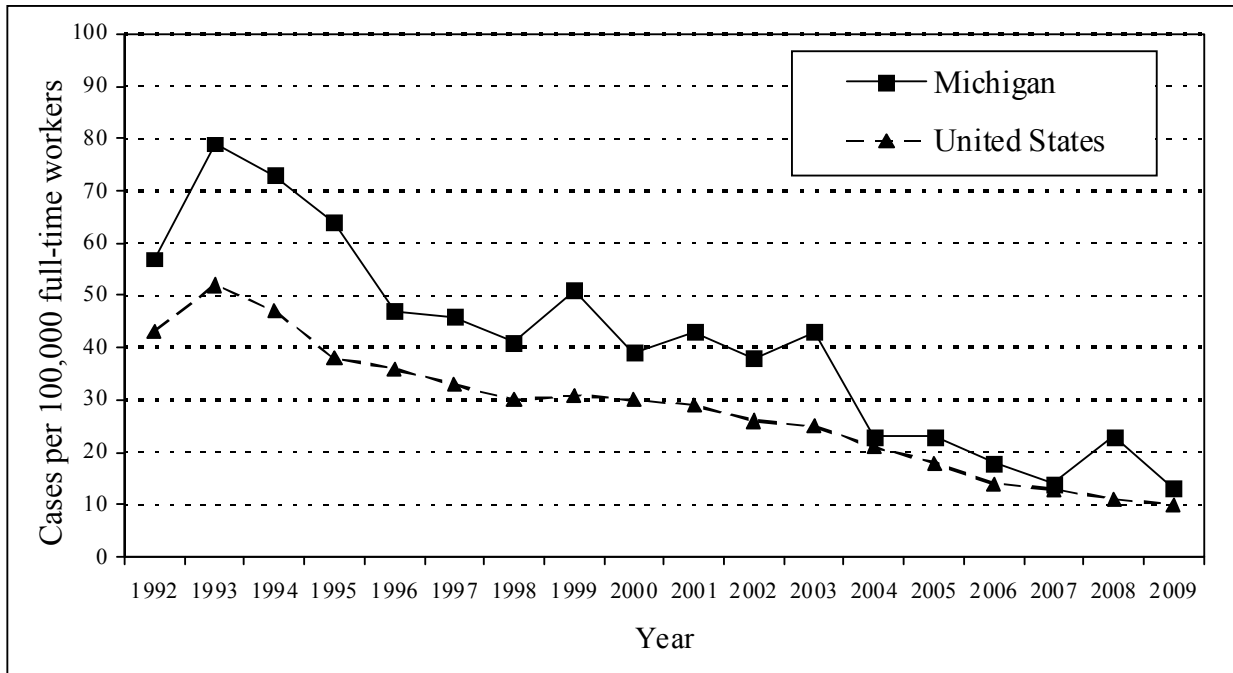
The Annual Survey is based on data collected from a nationwide sample of employers. While it is a valuable source of information about work-related injuries, it has a number of limitations. Public sector workers such as firefighters and police were excluded from national estimates prior to 2008. Self-employed, household workers, and workers on farms with fewer than eleven employees continue to be excluded. Together these sectors comprise approximately 21% of the U.S. workforce.⁴ In addition, there is evidence that MSDs are under-recorded on the Occupational Safety and Health Administration (OSHA) logs that serve as the basis for the Annual Survey.^{5,6} The Annual Survey is also subject to sampling error.

FIGURE 7.A
 Rates of all work-related musculoskeletal disorders* involving days away from work reported by private sector employers, Michigan and United States, 1992-2009



* Defined as one of the following conditions resulting from overexertion, repetitive motion, or bending/climbing/crawling/reaching/twisting: sprains, strains, tears; back pain, hurt back; soreness, pain, hurt except the back; carpal tunnel syndrome; hernia; or musculoskeletal system and connective tissue diseases and disorders.
Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

FIGURE 7.B
 Rates of carpal tunnel syndrome* involving days away from work
 reported by private sector employers, Michigan and United States, 1992-2009



* Defined as being due to overexertion, repetitive motion, or bending/climbing/crawling/reaching/twisting.
Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Indicator 8: Carpal Tunnel Syndrome Cases Identified in the Workers' Compensation System

Carpal tunnel syndrome (CTS) occurs when the median nerve is compressed at the wrist. Symptoms range from a burning, tingling, or numbness in the fingers to difficulty gripping or holding objects. Workplace factors that may cause or aggravate CTS include direct trauma, repetitive forceful motions or awkward postures of the hands, and use of vibrating tools or equipment.¹⁷

According to the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses (Annual Survey), there were an estimated 9,150 lost workday cases of CTS in the private sector nationwide in 2009. The corresponding incidence rate was 1.0 per 10,000 (or 10 per 100,000) full-time workers. The average number of days away from work for CTS was much greater than for all conditions (21 and 9 days, respectively).

Claims data from workers' compensation provide an independent, supplemental source of information about this form of musculoskeletal disorder, as compared to Indicator #7 which is based on Annual Survey data. For this indicator, cases were limited to claims resulting in wage compensation (incidents resulting in a disability for more than seven consecutive days). The first year of available data was 1997.

Figure 8 illustrates the annual rates of carpal tunnel syndrome claims identified in the Michigan workers' compensation system for the period 1997-2009 (results for 2004 and 2005 were unavailable due to an irretrievable loss of data for those years). There are no national data on workers' compensation claims to use as a comparison. Table 8 in Appendix A contains the annual numbers and rates. While there was no consistent trend during this time period, rates clearly have decreased since the late 1990's. The average annual rate during 1997-1999 was 24.0 per 100,000 compared to 11.7 per 100,000 during 2007-2009.

Comparison to Indicator 7

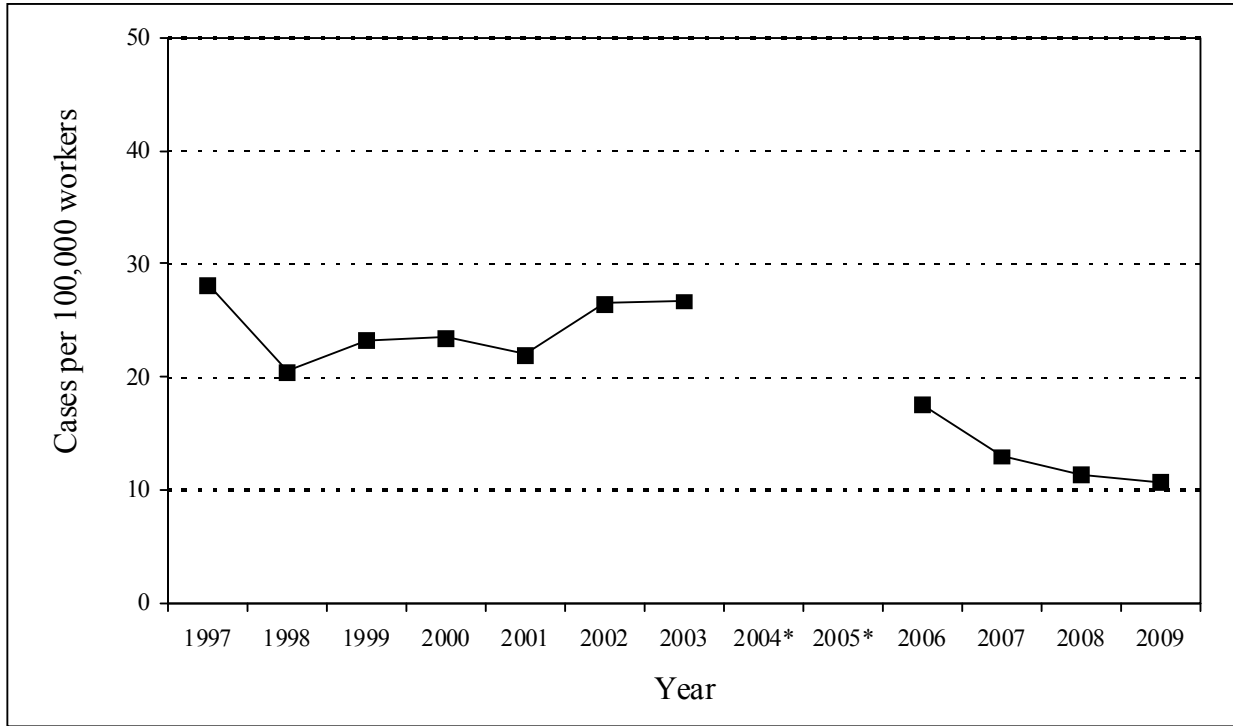
The average annual number of CTS cases reported by employers (Indicator 7) was 23% greater than the average annual number identified via workers' compensation claims between 1997 and 2009* (1,042 and 850, respectively). There was an even larger discrepancy between the average annual rates per BLS and workers' compensation (33.5 vs. 20.3, a 65% difference). [Note that the denominators in the rate calculations differed: BLS produces rates based on full time equivalents, not simply the average number employed.]

The downward trend of the BLS rates (an average rate decrease of 3.5 per 100,000 annually) was steeper than the downward trend of the workers' compensation-based rates (1.5 per 100,000 annually).

Differences in case definitions may partially explain the differences in the number of cases identified by each system. In a BLS case, the worker must have lost at least one day from work as a result of the condition. In a workers' compensation case, the worker must have missed more than seven consecutive days.

* The comparison excludes data for the years 2004 and 2005.

FIGURE 8
 Rate of lost work time claims for carpal tunnel syndrome cases identified in
 Michigan's workers' compensation system, 1997-2009



* Data not available. In April 2005, the Workers' Compensation Agency in the Department of Licensing and Regulatory Affairs sustained a massive loss of workers' compensation claims data without proper backup. Thus, data for 2004 were unavailable when requested in August 2005. A substantial portion of 2005 data were also lost and therefore are not included in the figure.

Data sources: Number of CTS cases: State workers' compensation systems. Number of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

Indicator 9: Pneumoconiosis Hospitalizations

Pneumoconiosis is a term for a class of non-malignant lung diseases caused by inhaling mineral dust, nearly always in occupational settings. Most cases of pneumoconiosis develop only after many years of cumulative exposure; thus they are usually diagnosed in older individuals, long after the onset of exposure. These diseases are incurable and may ultimately result in death.¹⁸

Pneumoconiosis includes: silicosis, asbestosis, coal workers' pneumoconiosis (CWP), and, less commonly, pneumoconiosis due to a variety of other mineral dusts, including talc, aluminum, bauxite, and graphite. Byssinosis and several other dust-related lung diseases are sometimes grouped with "pneumoconiosis" even though they are caused by occupational exposure to organic (e.g., cotton) dust. Individuals with certain kinds of pneumoconiosis are at increased risk of other diseases, including cancer, tuberculosis, autoimmune conditions, and chronic renal failure.

State-based hospital discharge data are a useful population-based data source for quantifying pneumoconiosis even though only a small number of individuals with pneumoconiosis are hospitalized for that condition. In contrast, it is widely recognized that the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses (Annual Survey) identifies very few cases of pneumoconiosis and other long latency diseases. For example, the Annual Survey estimated that in 2004, there were 50 pneumoconiosis cases in private industry nationwide, while there were 27,146 pneumoconiosis hospital discharges that year (a more recent comparison cannot be made since there were too few cases each year during 2005-2009 for BLS to generate a reliable estimate). Thus, hospital discharge data are an important source for quantifying the burden of pneumoconiosis, even though they capture only hospitalized cases.

Age-standardized rates are used in trend analyses and geographic comparisons (e.g., Michigan and U.S) because age-standardization removes the effect of differing age distributions. Between 1990 and 2009, the age standardized hospitalization rate for pneumoconiosis among Michigan residents aged 15 and older increased 56%, from 76.3 to 119.3 per million residents (Table 9.A in Appendix A). The increase can be attributed to asbestosis: the asbestosis hospitalization rate increased 403% while rates for coal workers' pneumoconiosis, silicosis and other/unspecified pneumoconioses all decreased during this time period (by 85%, 43%, and 62%, respectively). (See Tables 9.B-9.E in Appendix A.)

As seen in Figure 9, national pneumoconiosis rates vary substantially from year to year – this is primarily because of the sampling error inherent in the National Hospital Discharge Survey (NHDS). National rates for pneumoconiosis increased from 1990 to 1997, then generally decreased so that in 2009 they were lower than in 1990. National rates for asbestosis peaked in 2002, then decreased and approached early 1990's levels. While national rates for pneumoconiosis overall and asbestosis exceeded Michigan's rates up through 2002, they both fell below the state's rates in the subsequent years.

For coal workers' pneumoconiosis, the national rate exceeded Michigan's rate from 1990-2005 (for 2006-2009, national rates were considered too unstable statistically to report. (See Tables 9.A-9.C in Appendix A for comparative national data.) Due to statistical instability of national estimates of silicosis, no state-national comparison of this type of pneumoconiosis can be made.

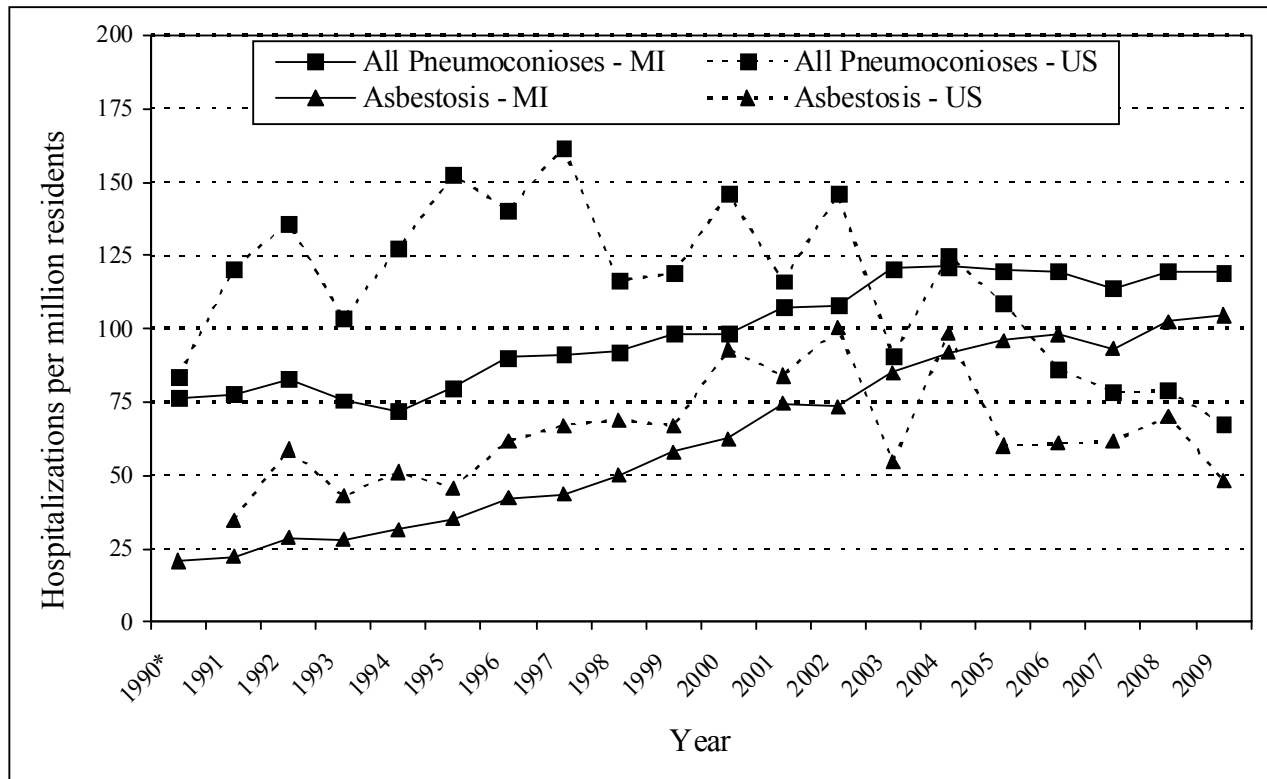
The sources of state and national data have differences which may limit their comparability:

- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the NHDS. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.
- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations. For example, in 2009, 2.7% of all Michigan resident hospitalizations from or with pneumoconiosis were at out-of-state hospitals.

Michigan's Silicosis Surveillance System

Two states, including Michigan, have active programs for silicosis surveillance that utilize multiple data sources and a rigorous process for confirming cases. Michigan has confirmed 988 individuals with silicosis from 1990-2009. Hospitals and death certificates are two of several data sources used in this system. Annual reports summarizing Michigan's data from 1997 through 2010 are available at: <http://www.oem.msu.edu/AnnualReports.aspx>.

FIGURE 9
 Age-standardized rates of hospitalization from or with any form of pneumoconiosis and asbestosis, ages 15 and older, Michigan and United States, 1990-2009



* National estimate of asbestosis for 1990 not presented due to statistical instability.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau.

Technical Notes:

- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- A pneumoconiosis case is defined as a hospital discharge with a principal or secondary diagnosis in the ICD-9-CM³⁹ code range 500-505. An asbestosis case is defined as a hospital discharge with a principal or secondary diagnosis with the ICD-9-CM code 501.
- Some individuals are hospitalized more than once for pneumoconiosis. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalizations for pneumoconiosis, not of individuals with pneumoconiosis.
- Michigan cases were ascertained by searching all available diagnoses for each patient (between 30 and 35, depending upon the year). National data were limited to searching the first seven listed diagnoses. A substantial number of pneumoconiosis cases are identified by searching all diagnoses. For example, in 2009, searching all diagnoses, 1,010 Michigan pneumoconiosis cases were identified. However, had only the first seven listed diagnoses been searched, this number would have been reduced to 474.

Indicator 10: Pneumoconiosis Mortality

All states collect cause-of-death information on death certificates, including both the underlying and contributing causes of death. From 1990 through 1999, pneumoconiosis (for a definition of pneumoconiosis, see page 23) was an underlying or contributing cause of more than 30,000 deaths in the United States, for an overall age-adjusted annual mortality rate of 15.8 per million population among those age 15 and older. Pneumoconiosis was the underlying cause of death in approximately one-third of these deaths. The mortality rate from most kinds of pneumoconiosis has gradually declined since 1972 with the exception of asbestosis, which has increased by about 500%.¹⁹

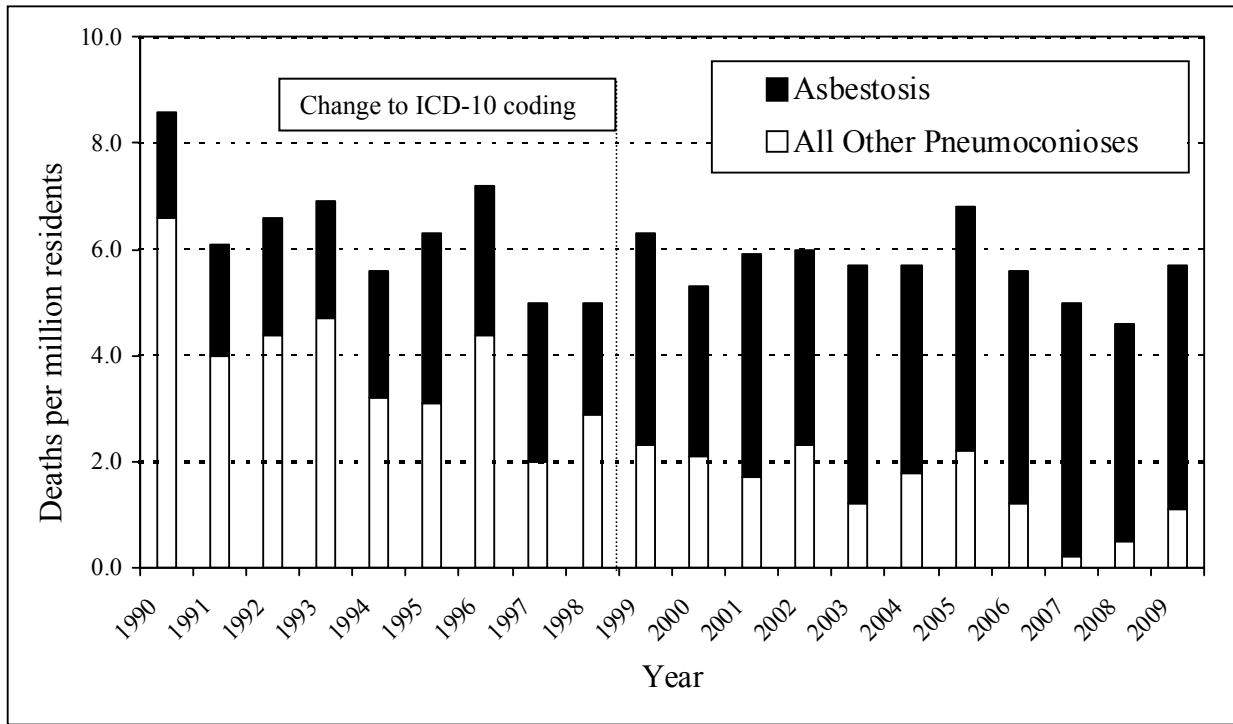
Deaths due to pneumoconiosis are undercounted on death certificates.^{20,21} Pneumoconiosis is likely to be under-recorded on the death certificate as a cause of death because it is under-recognized by clinicians for a number of reasons, including the long latency between exposure and onset of symptoms, and the non-specificity of symptoms.

Figure 10.A illustrates the annual age-adjusted rates for all pneumoconiosis deaths and for asbestosis deaths among Michigan residents aged 15 and older during the period 1990-2009. The rate for all pneumoconioses was highest in 1990 (8.6 deaths per million residents) and had declined by 34% by 2009. This decrease would have been more substantial if not for the increase in asbestosis deaths. The rate for asbestosis deaths increased 130% from 1990 to 2009 (from 2.0 to 4.6 deaths per million residents). Deaths from or with asbestosis accounted for 25% of all pneumoconiosis deaths in 1990. They comprised 80% in 2009.

Figure 10.B compares Michigan and U.S. death rates for all pneumoconiosis and asbestosis during 1990-2009. National pneumoconiosis death rates decreased more consistently and substantially (60%) than Michigan rates (34%) during this time period. National asbestosis death rates increased from 1990 to a peak in 2000 and thereafter decreased. Michigan asbestosis death rates increased, but did not have a similar decline. For both total pneumoconiosis and asbestosis, national rates have been consistently higher than Michigan rates.

The annual number of deaths and death rates for all types of pneumoconiosis for Michigan and the U.S. are presented in Table 10.A and Table 10.B, respectively, in Appendix A.

FIGURE 10.A
 Age-standardized mortality rates from or with all pneumoconioses and asbestosis,
 ages 15 and older, Michigan residents, 1990-2009

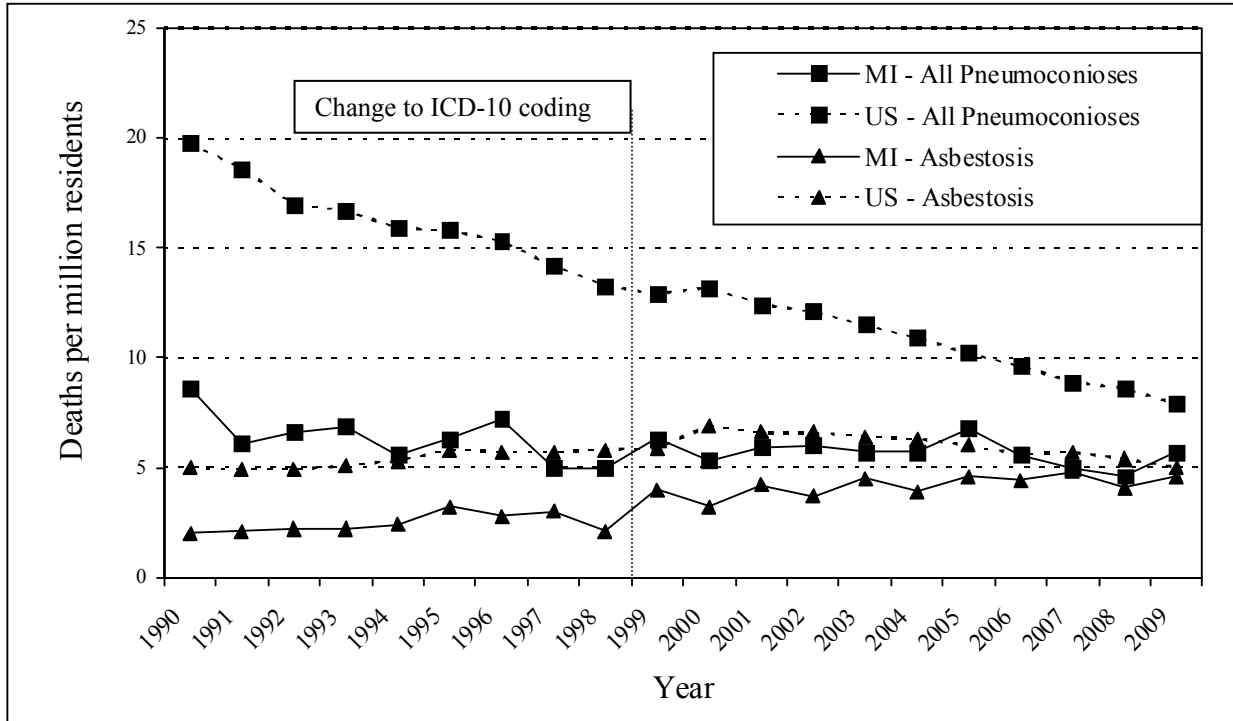


Data Sources: Numbers of deaths from or with pneumoconiosis: Vital Records and Health Data Development Section, Michigan Department of Community Health. Number of residents used to calculate rates: Population Division, United States Census Bureau.

Technical Notes:

See Technical Notes on page 28.

FIGURE 10.B
 Age-standardized mortality rates from or with all pneumoconioses and asbestosis,
 ages 15 and older, Michigan and United States, 1990-2009



Data Sources: Numbers of deaths from or with pneumoconiosis - Michigan: Vital Records and Health Data Development Section, Michigan Department of Community Health. Number of residents used to calculate rates - Michigan: Population Division, United States Census Bureau. Age-adjusted rates - United States: National Surveillance System for Pneumoconiosis Mortality, National Institute for Occupational Safety and Health.

Technical Notes:

- ICD-10³⁶ coding of mortality was implemented in 1999. From 1979 to 1998, mortality coding utilized ICD-9.⁴¹ This change from one coding system to another can affect enumeration of causes of death. For pneumoconiosis, the comparability ratio²² is estimated at 1.0178, meaning that the change in coding systems by itself inflates counts of post-1998 pneumoconiosis deaths by 1.0178, or 1.78%. No information is available on the comparability ratios for various forms of pneumoconiosis such as asbestosis.
- For 1990-1998, a pneumoconiosis case was defined as a death with the underlying or contributing cause coded in the ICD-9 range 500-505. Asbestosis was defined as a death coded with ICD-9 501.
- For 1999-2009, a pneumoconiosis case was defined as a death with the underlying or contributing cause coded in the ICD-10 range J60-J66. Asbestosis was defined as a death coded with ICD-10 J61.

Indicator 11: Acute Work-related Pesticide Associated Illness and Injury Reported to Poison Control Centers

A pesticide is a substance or mixture of substances used to prevent or control the presence of undesired insects, plants, animals, fungi, germs, or other pests. In the U.S., approximately one billion pounds of pesticides are used annually, contained in more than 16,000 pesticide products.²³ Although the value of pesticides in protecting the food supply and controlling disease vectors is well recognized, it is also recognized that pesticides can cause harm to people and the environment. Adverse health effects from exposure vary depending on the amount and route of exposure and the type of chemical used. Agricultural workers and pesticide applicators are at greatest risk for the more severe pesticide poisonings.

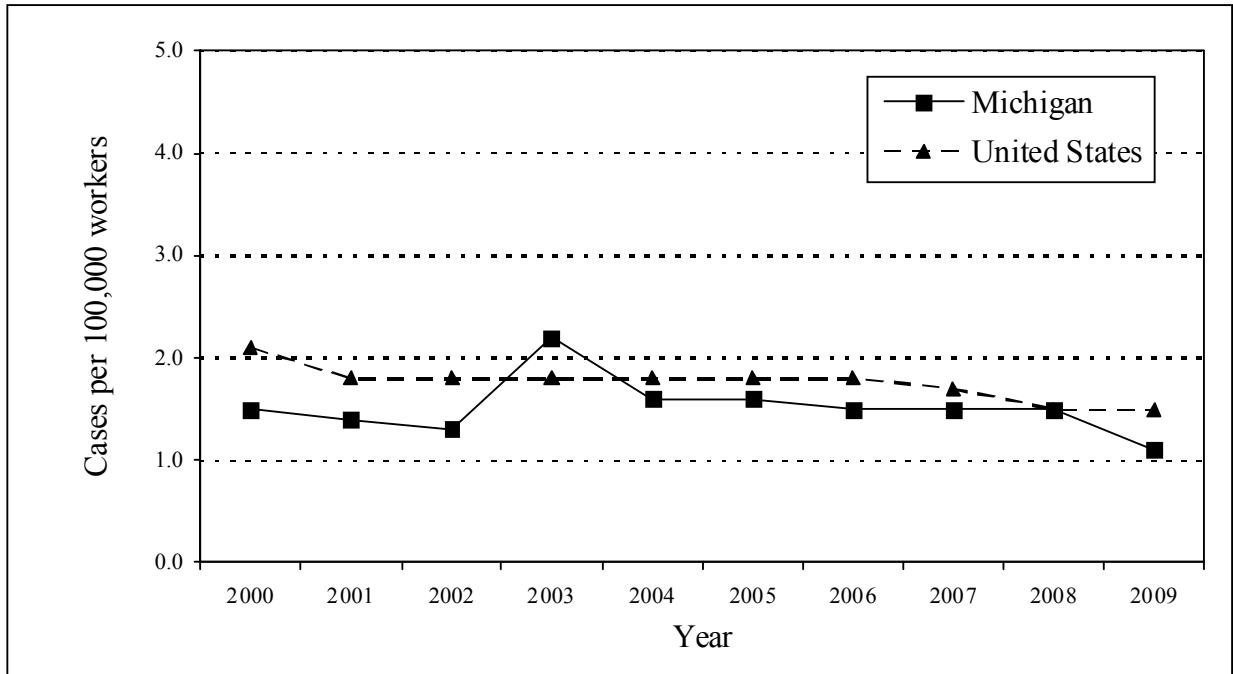
The U.S. Environmental Protection Agency (EPA) estimates that there are 20,000 to 40,000 physician-treated work-related pesticide poisonings per year.²⁴ National estimates of pesticide poisoning are not available from the Bureau of Labor Statistics. Poison Control Center (PCC) data are useful for monitoring pesticide poisonings nationally because PCCs service the entire U.S. population, even though calls to state and regional PCCs are estimated to capture only about 10% of acute occupational pesticide-related illness cases.²⁵

Michigan data for this indicator were derived from reports to the state's Poison Control Center. U.S. results were based on data from the National Poison Data System (NPDS), a national database of reports to PCCs throughout the U.S. compiled by the American Association of Poison Control Centers. Figure 11 illustrates the annual work-related pesticide poisoning rates for Michigan and the U.S. during 2000 to 2009. Michigan's rates were generally less than national rates except for 2003, when the state had an anomalous spike.

Michigan's Occupational Pesticide Illness and Injury Surveillance System

A small number of states (11 as of April 2013) have active programs for occupational pesticide poisoning surveillance that utilize multiple data sources and a rigorous process for confirming cases. These states, including Michigan, documented 7,638 individuals with acute occupational pesticide-related illness during 1998-2009. The Michigan Department of Community Health joined these states in 2001 by instituting an occupational pesticide poisoning surveillance system through funding from NIOSH. Michigan's Poison Control Center is one of several data sources for this system. Annual reports summarizing Michigan data for mid-2001 through 2011 are available at: <http://www.oem.msu.edu/AnnualReports.aspx>.

FIGURE 11
Rate of work-related pesticide-associated poisonings
Michigan and United States, 2000-2009



Data Sources: Numbers of work-related pesticide-associated poisonings: American Association of Poison Control Centers. Employment statistics used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

Technical Notes:

- Cases are counted in the NPDS data system according to the following variable definitions:
 - Exposure to an agent included in one of the pesticide generic categories: fungicides, fumigants, herbicides, insecticides, repellents, disinfectants, or rodenticides; AND
 - Reason=occupational OR Exposure site=workplace; AND
 - Medical outcome is one of the following: minor effect; moderate effect; major effect; death; not followed, minimal clinical effects possible; or, unable to follow, judged as potentially toxic exposure.
- Cases involving exposure to mixtures were excluded.

Indicator 12: Incidence of Malignant Mesothelioma

Malignant mesothelioma is a rare but highly fatal cancer of the thin membranes surrounding the chest cavity (pleura) or abdominal cavity (peritoneum). Much less frequently, this tumor affects other anatomical sites (e.g., pericardium). The only well-established risk factor for mesothelioma is exposure to asbestos fibers. Prior asbestos exposure, with the majority of cases occurring after exposure in the workplace, has been reported in 62 to 85 percent of all mesothelioma cases.²⁶

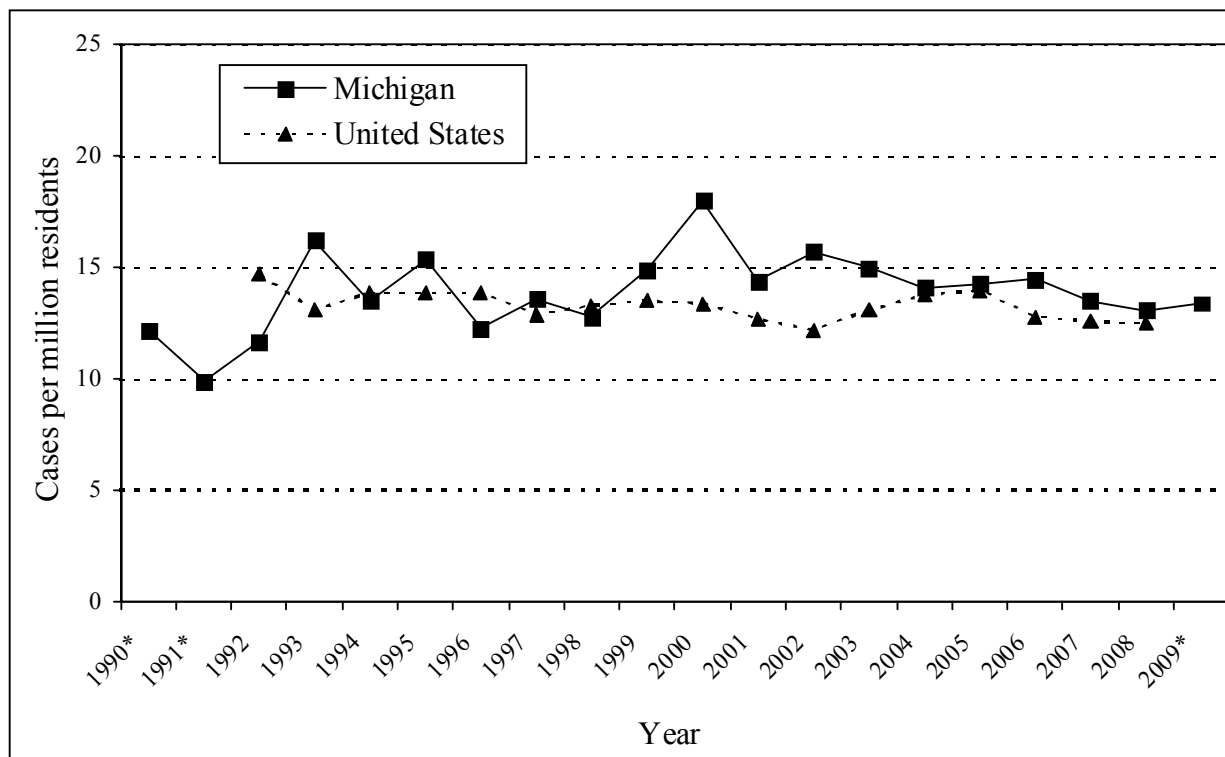
Mesothelioma is a disease of long latency, typically with 20-40 years between first exposure to asbestos and disease onset. The incidence of mesothelioma in the United States has risen steadily since the 1960s, reflecting high levels of asbestos use and occupational exposure to asbestos during World War II through the 1970s. In the 1970s, new Occupational Safety and Health Administration regulations limited workplace exposures and the Environmental Protection Agency began regulating asbestos use.

Approximately 1.3 million workers continue to be exposed to asbestos in many industries and activities.²⁷ Environmental exposure to asbestos is also a continuing concern. Asbestos-containing materials are found in hundreds of thousands of schools and public buildings throughout the country, and asbestos continues to be used in many manufactured products.

Michigan data for 1990-2009 were provided by the Michigan Cancer Registry which collects data on newly diagnosed cancer cases among state residents. National cancer rates for 1992-2003 were based on estimates by the National Cancer Institute. These estimates were made from data supplied by thirteen state cancer registries participating in the Surveillance, Epidemiology, and End Results (SEER) program.²⁸ National numbers and rates for 2004-2008 were based on North American Association of Central Cancer Registries (NAACCR) data²⁹.

Figure 12 illustrates age-standardized incidence rates of malignant mesothelioma among Michigan and U.S. residents aged 15 and older for 1990-2009 and 1992-2008, respectively (U.S. rates were not available for all years). During the twenty-year period there was no upward or downward trend for either the U.S. or Michigan. Michigan's average annual rates were slightly higher than the nation's during 1992-2008 (14.3 v. 13.3 per million, respectively). Annual numbers and rates of mesothelioma cases are presented in Table 12 in Appendix A.

FIGURE 12
 Age-standardized incidence rate of malignant mesothelioma,
 ages 15 and older, Michigan and U.S. residents, 1990-2009



*National data not available.

Data sources: Number of Michigan mesothelioma cases: Michigan Cancer Registry. Number of residents used to calculate Michigan rates: Population Division, United States Census Bureau. National rates for 1992-2003 are estimates provided by the National Cancer Institute using the Surveillance, Epidemiology and End Results (SEER) program. National rates for 2004-2008 are from the North American Association of Central Cancer Registries (NAACCR).

Technical Note:

A mesothelioma case is coded in the International Classification of Diseases for Oncology (ICD-O)³⁷ histology range 9050-9053.

Indicator 13: Elevated Blood Lead Levels Among Adults

Lead poisoning among adults is primarily (~80%) due to occupational exposure. Lead adversely affects multiple organ systems and can cause permanent damage. Exposure to lead in adults can cause anemia, nervous system dysfunction, kidney damage, hypertension, decreased fertility, and miscarriage. Workers bringing lead dust home on their clothing or shoes can expose their children to lead.

The blood lead level (BLL) is the best biological indicator of recent lead exposure. The Michigan Occupational Safety and Health Administration requires that employers regularly monitor the BLLs of workers where airborne lead in the workplace exceeds certain levels. The *Healthy People 2010* goal is to eliminate BLLs above 25 micrograms per deciliter ($\mu\text{g}/\text{dL}$) among lead-exposed workers.³⁰ If a worker's average BLL is 50 $\mu\text{g}/\text{dL}$ or greater, the employer is required to remove the worker from exposure. However, adverse health effects have been found at BLLs lower than 40 $\mu\text{g}/\text{dL}$ ³¹ and 25 $\mu\text{g}/\text{dL}$.³² The average BLL for the general population is less than two $\mu\text{g}/\text{dL}$.³³

Forty-one states, including Michigan, participate in compiling data on clinical laboratory reports of BLLs in adults for the national Adult Blood Lead Epidemiology and Surveillance (ABLES) program.³⁴ (Annual reports summarizing Michigan's data for 1998-2011 are available at: <http://www.oem.msu.edu/AnnualReports.aspx>.) Reporting by clinical laboratories is mandatory in these states. The regulation for laboratories to report BLLs to the Michigan Department of Community Health went into effect in October, 1997. In Michigan in 2010, occupational exposure accounted for 84% of all reported adults with elevated BLLs.³⁵

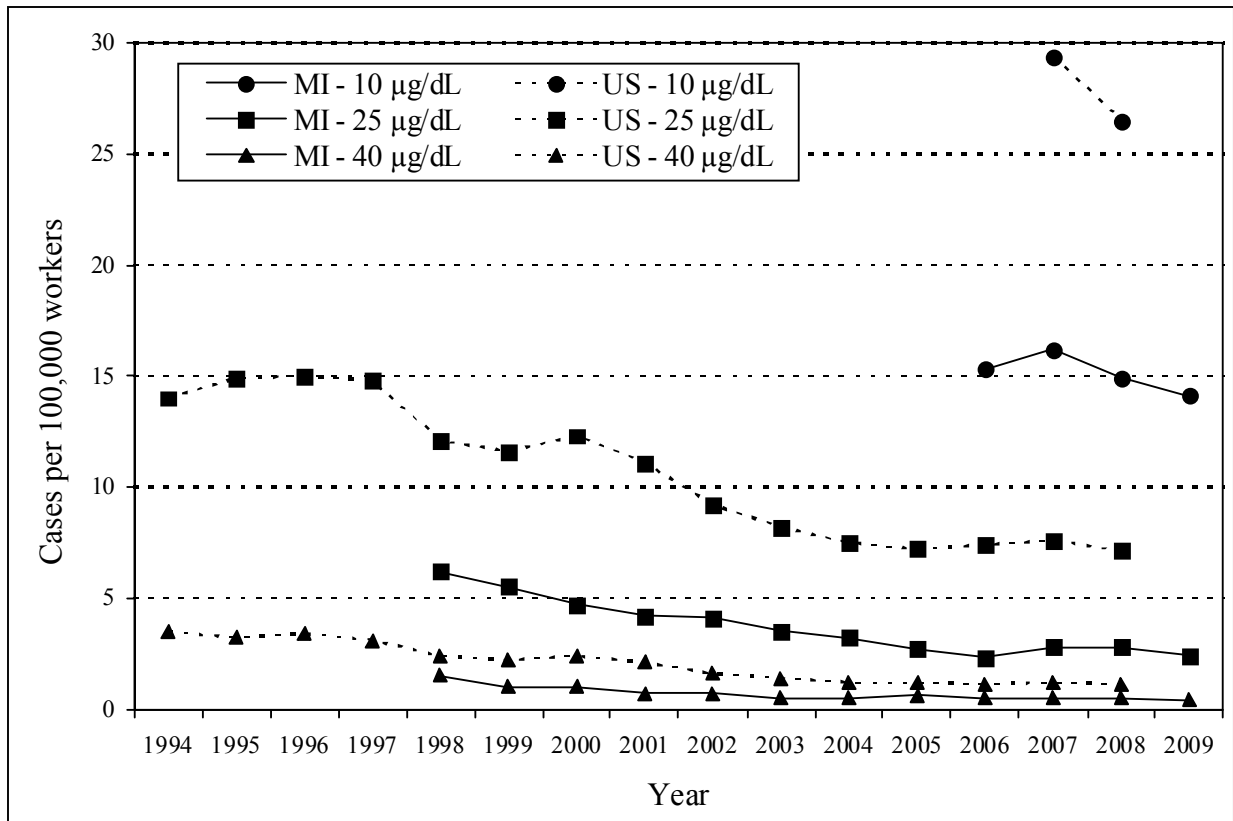
This indicator originally quantified prevalence and incidence of individuals with BLLs ≥ 25 $\mu\text{g}/\text{dL}$ and ≥ 40 $\mu\text{g}/\text{dL}$. The CSTE Occupational Health Surveillance Subcommittee subsequently recognized that BLLs at or exceeding 10 $\mu\text{g}/\text{dL}$ were indicative of serious lead exposure. Thus, the Subcommittee recommended that starting in 2006, the indicator be expanded to include prevalence and incidence of BLLs ≥ 10 $\mu\text{g}/\text{dL}$.

Figure 13A presents prevalence rates of BLLs ≥ 10 $\mu\text{g}/\text{dL}$, ≥ 25 $\mu\text{g}/\text{dL}$, and ≥ 40 $\mu\text{g}/\text{dL}$ among Michigan (for 1998-2009) and U.S. (for 1994-2008) workers aged 16 and older. Prevalence rates for BLLs ≥ 25 $\mu\text{g}/\text{dL}$ and 40 $\mu\text{g}/\text{dL}$ decreased both in the state and nationally [There were too few years to evaluate trend for BLLs ≥ 10 $\mu\text{g}/\text{dL}$.] For the two higher measures during the period in common (1998-2008), national rates on average were more than double Michigan rates. For ≥ 10 $\mu\text{g}/\text{dL}$, national rates were slightly less than twice the state rate.

Figure 13B illustrates incidence rates of elevated BLLs for Michigan (1999-2009) and the U.S. (1994-2008) (national incidence data for BLLs ≥ 10 $\mu\text{g}/\text{dL}$ are not available). Michigan incidence rates for 1998 are not included as it was not possible to accurately calculate them due to incomplete prevalence data for 1997 (see Technical Notes on page 35 for a description of how incidence is calculated). Incidence rates for BLLs ≥ 25 $\mu\text{g}/\text{dL}$ and ≥ 40 $\mu\text{g}/\text{dL}$ decreased both in the state and nationally. For both measures during 1999-2008, national rates on average exceeded Michigan rates although to a lesser degree than for prevalence.

Tables 13.A – 13.D in Appendix A present annual prevalence and incidence data for Michigan and the U.S. for the three BLL measures.

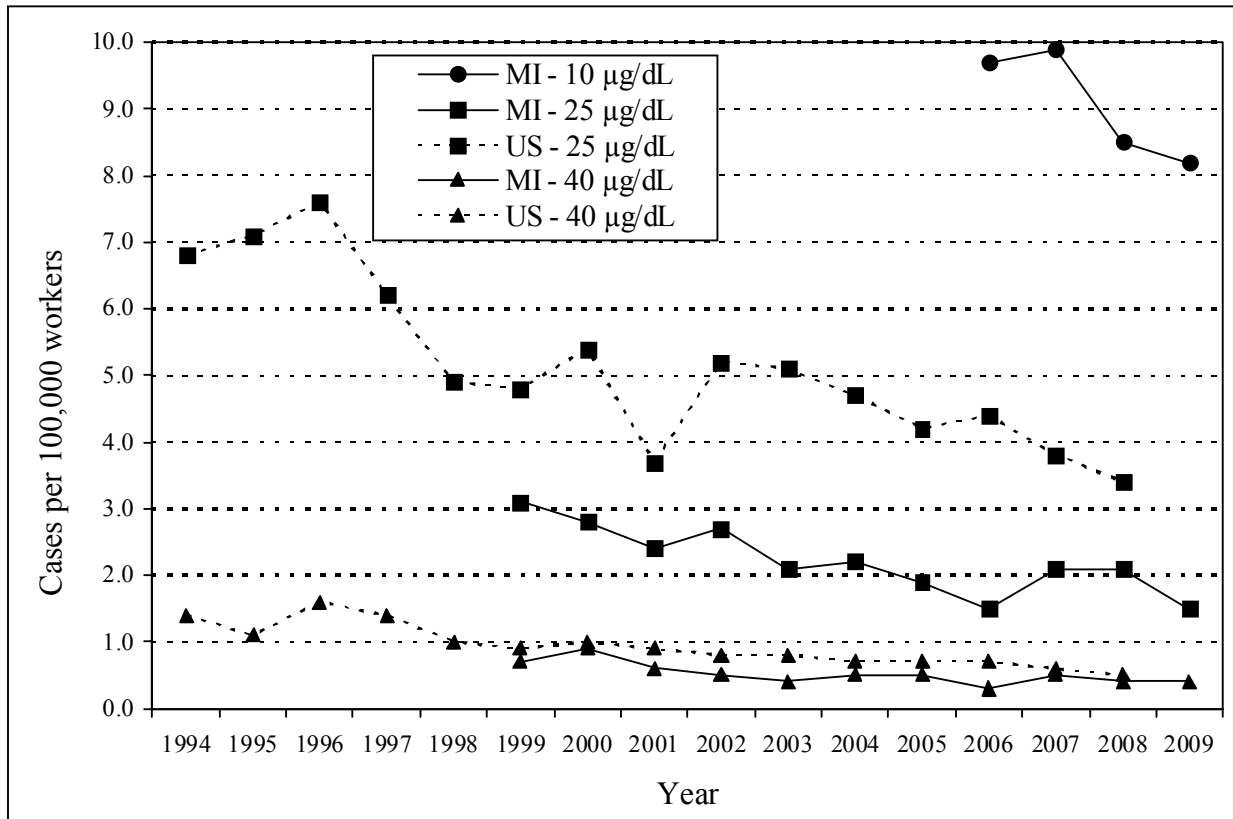
FIGURE 13.A
 Prevalence rates of Michigan and U.S. workers aged 16 and older with
 blood lead levels $\geq 10 \mu\text{g/dL}$, $\geq 25 \mu\text{g/dL}$, and $\geq 40 \mu\text{g/dL}$, 1994-2009



Data sources: Number of cases with elevated blood lead levels: Michigan and U.S. Adult Blood Lead Epidemiology Surveillance programs. Employment statistics used to calculate rates: MI: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment; US: BLS Local Area Unemployment Statistics.

FIGURE 13.B

Incidence rates of Michigan and U.S. workers aged 16 and older with blood lead levels $\geq 10 \mu\text{g/dL}$, $\geq 25 \mu\text{g/dL}$, and $\geq 40 \mu\text{g/dL}$, 1994-2009



National incidence data for blood lead levels $\geq 10 \mu\text{g/dL}$ are not available.

Data sources: Number of cases with elevated blood lead levels: Michigan and U.S. Adult Blood Lead Epidemiology Surveillance programs. Employment statistics used to calculate rates: MI: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment; US: BLS Local Area Unemployment Statistics.

Technical Notes:

- A prevalent case is a person reported at least once in the calendar year with a BLL greater than or equal to 10 $\mu\text{g/dL}$ (or 25, 40 $\mu\text{g/dL}$).
- An incident case is a person with a BLL greater than or equal to 10 $\mu\text{g/dL}$ (or 25, 40 $\mu\text{g/dL}$) who was reported in the calendar year, but not reported in the immediately preceding calendar year with a BLL greater than or equal to 10 $\mu\text{g/dL}$ (or 25, 40 $\mu\text{g/dL}$).
- Rates include all cases of adult elevated BLL reports in the numerators, but the denominators are limited to employed persons. This will result in a slight overestimate of rates per 100,000 employed persons because a small percentage (~10%) of the elevated levels occurs in individuals not employed.
- Data published by the ABLES Program may differ from Indicator 13 data because: 1) Indicator 13 includes only resident adults, while ABLES data include all adults reported by each state (residents and nonresidents); 2) lead registries continually correct detected errors, thus published numbers may change over time; 3) Indicator 13 and ABLES use slightly different employment populations to calculate rates.
- U.S. rates are weighted averages based on reports from participating ABLES states. The number of ABLES states increased from 17 in 1994 to 40 in 2009.

APPENDIX A

Data Tables

TABLE 1.A
 Number of non-fatal work-related injuries and illnesses reported by private sector employers
 by year and type of case, Michigan and United States, 1992-2009

Year	All Cases		Cases with Days Away From Work		Cases with > 10 Days Away From Work	
	MI (000's)	US (000's)	MI (000's)	US (000's)	MI (000's)	US (000's)
1992	299.1	6,799	81.7	2,331	34.0	872.3
1993	310.0	6,737	80.9	2,253	33.5	825.8
1994	337.0	6,767	86.6	2,237	36.5	815.4
1995	332.0	6,575	83.9	2,041	34.0	722.0
1996	327.5	6,239	74.7	1,881	28.9	684.7
1997	298.7	6,146	68.9	1,833	28.1	676.0
1998	280.5	5,923	60.4	1,731	24.2	636.6
1999	269.7	5,707	59.5	1,703	23.8	635.5
2000	262.0	5,650	59.5	1,664	24.4	639.0
2001	226.9	5,216	49.9	1,538	19.9	605.9
2002	202.5	4,701	48.8	1,436	21.8	614.6
2003	185.1	4,365	44.7	1,316	21.6	581.9
2004	163.4	4,257	35.7	1,259	17.2	543.8
2005	161.7	4,214	37.9	1,235	16.7	522.2
2006	149.6	4,085	33.6	1,184	14.7	504.6
2007	139.6	4,003	32.2	1,159	14.6	500.8
2008	124.4	3,696	30.1	1,078	13.9	479.3
2009	108.3	3,278	26.0	965	12.0	429.8

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

TABLE 1.B

Rates of non-fatal work-related injuries and illnesses reported by private sector employers by year and type of case, Michigan and United States, 1992-2009

Year	All Cases		Cases with Days Away From Work	
	MI	US	MI	US
1992	11,100	8,900	3,000	3,000
1993	10,800	8,500	2,800	2,900
1994	11,500	8,400	3,000	2,800
1995	10,900	8,100	2,800	2,500
1996	10,600	7,400	2,400	2,200
1997	9,100	7,100	2,100	2,100
1998	8,600	6,700	1,800	2,000
1999	8,100	6,300	1,800	1,900
2000	8,100	6,100	1,800	1,800
2001	7,300	5,700	1,600	1,700
2002	6,800	5,300	1,600	1,600
2003	6,300	5,000	1,500	1,500
2004	5,600	4,800	1,200	1,400
2005	5,300	4,600	1,200	1,400
2006	5,000	4,400	1,100	1,300
2007	4,900	4,200	1,100	1,200
2008	4,400	3,900	1,100	1,100
2009	4,200	3,600	1,000	1,100

Rates are the number of cases per 100,000 full-time workers.*

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

* The rates published by BLS are the number of injury and illness cases per 100 full-time workers. The rates presented here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 1,000. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 2
 Number and rate of work-related hospitalizations
 Michigan and United States, 1990-2009

Year	Michigan		United States	
	Number	Rate	Number	Rate
1990	7,496	176.5	399,468	336.3
1991	7,097	170.4	379,215	322.1
1992	6,923	162.0	340,840	287.6
1993	7,444	168.5	387,938	322.6
1994	7,356	162.1	298,367	242.5
1995	6,011	133.8	233,701	187.1
1996	5,875	126.1	223,879	176.7
1997	5,866	122.8	228,031	176.0
1998	5,404	111.8	228,154	173.5
1999	5,338	108.0	211,910	158.7
2000	5,618	112.0	192,109	140.3
2001	5,371	109.6	173,724	126.9
2002	5,114	109.0	193,752	142.0
2003	4,913	105.1	184,986	134.0
2004	4,549	95.6	170,796	122.7
2005	4,562	95.3	169,814	119.8
2006	4,260	90.0	154,877	107.2
2007	4,113	88.1	165,441	113.3
2008	3,985	88.1	144,184	99.2
2009	3,416	80.3	135,825	97.1

Rates are the number of hospitalizations per 100,000 workers.
 Michigan data reflect Michigan residents hospitalized in-state.
 U.S. data are estimates based on a sample.

Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: MI – BLS Geographic Profile of Employment and Unemployment; US – BLS Employment and Earnings.

TABLE 3
 Number and rate of fatal work-related injuries
 Michigan and United States, 1994-2009

Year	Michigan		United States	
	Number	Rate	Number	Rate
1994	180	4.2	6,632	5.7
1995	149	3.5	6,275	5.3
1996	155	3.5	6,202	5.1
1997	174	3.9	6,238	5.0
1998	179	3.8	6,055	4.8
1999	182	3.8	6,054	4.7
2000	156	3.3	5,920	4.5
2001	175	3.8	5,915	4.6
2002	152	3.4	5,534	4.3
2003	152	3.5	5,575	4.2
2004	127	2.8	5,764	4.3
2005	110	2.5	5,734	4.2
2006	157	3.5	5,840	4.2
2007	120	2.8	5,657	4.0
2008	123	2.9	5,214	3.7
2009	94	2.5	4,551	3.5

Rates are number of deaths per 100,000 FTE for those aged 16 and older.

Data sources: Numbers of deaths: Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries. Number of Full Time Equivalents used to calculate rates: Current Population Survey data ascertained through Data Ferrett.

TABLE 4

Number and rate of non-fatal amputations resulting in days away from work reported by private sector employers, Michigan and United States, 1992-2009

Year	Michigan		United States	
	Number	Rate	Number	Rate
1992	380	14	12,352	16
1993	549	19	11,342	14
1994	610	21	12,222	15
1995	377	12	11,309	14
1996	563	18	10,167	12
1997	440	14	10,852	13
1998	416	13	10,243	12
1999	479	14	9,985	11
2000	312	10	9,658	11
2001	407	13	8,612	10
2002	253	9	8,793	10
2003	280	10	8,150	9
2004	390	13	8,160	9
2005	330	11	8,450	9
2006	560	19	7,990	9
2007	160	5	7,320	8
2008	240	9	6,230	7
2009	150	6	5,930	7

Rates are the number of cases per 100,000 FTE.

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical note: The rates published by BLS are the number of amputation cases per 10,000 FTEs. The rates presented here, which are amputation cases per 100,000 FTEs, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 5
 Number and rate of lost wage claims for amputations identified in
 Michigan's workers' compensation system, 1997-2006

Year	Number	Rate
1997	592	14.3
1998	595	14.0
1999	527	12.1
2000	487	11.0
2001	403	9.3
2002	388	9.1
2003	266	6.4
2004	NA	NA
2005	NA	NA
2006	278	6.8
2007	248	6.2
2008	233	6.0
2009	142	3.9

Rates are the number of cases per 100,000 workers covered by workers' compensation.

NA – Not available. In April 2005, the Workers' Compensation Agency in the Department of Licensing and Regulatory Affairs sustained a massive loss of workers' compensation claims data without proper backup. Thus, data for 2004 were unavailable when requested in August 2005. A substantial portion of 2005 data were also lost and therefore are not included in the table.

Data sources: Number of cases: Michigan workers' compensation system. Number of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

TABLE 6
Number and rate of hospitalizations for work-related burns
Michigan and United States, 1990-2009

Year	Michigan		United States	
	Number	Rate	Number	Rate
1990	159	3.7	11,040	9.3
1991	162	3.9	7,463 ¹	6.3 ¹
1992	106	2.5	5,649 ¹	4.8 ¹
1993	92	2.1	7,538 ¹	6.3 ¹
1994	134	3.0	5,716 ¹	4.6 ¹
1995	115	2.6	6,128 ¹	4.9 ¹
1996	101	2.2	— ²	— ²
1997	108	2.3	— ²	— ²
1998	89	1.8	6,270 ¹	4.8 ¹
1999	105	2.1	5,176 ¹	3.9 ¹
2000	121	2.4	5,370 ¹	3.9 ¹
2001	110	2.2	— ²	— ²
2002	87	1.9	— ²	— ²
2003	100	2.1	5,441 ¹	4.0 ¹
2004	111	2.3	8,251 ¹	5.9 ¹
2005	100	2.1	6,463 ¹	4.6 ¹
2006	82	1.7	5,483 ¹	3.8 ¹
2007	83	1.8	6,158 ¹	4.2 ¹
2008	63	1.4	— ²	— ²
2009	57	1.3	— ²	— ²

1. Per National Center for Health Statistics recommendations, estimates of between 5,000 and 10,000 are to be used with caution.

2. Per National Center for Health Statistics recommendations, estimates of less than 5,000 are not to be used.

Michigan data reflect Michigan residents hospitalized in-state.

U.S. data are estimates as they are based on a sample.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

TABLE 7.A
Work-related Musculoskeletal Disorders Involving Days Away from Work
Michigan and United States, 1992-2009

All Musculoskeletal Disorders				
Year	Michigan		United States	
	Number	Rate	Number	Rate
1992	29,938	1,107	784,145	1,025
1993	30,201	1,057	762,727	967
1994	32,744	1,118	755,594	936
1995	31,119	1,026	695,789	853
1996	35,522	1,149	647,355	770
1997	23,467	718	626,352	725
1998	21,711	663	592,544	668
1999	20,308	608	557,265	616
2000	21,017	650	577,814	629
2001	17,378	562	522,528	575
2002	16,303	550	487,915	553
2003	15,560	533	435,180	496
2004	11,940	406	402,700	452
2005	11,280	370	375,540	413
2006	9,840	330	357,160	386
2007	8,690	303	335,390	354
2008	7,900	282	317,440	334
2009	7,290	282	283,800	313

Rates are the number of cases per 100,000 full-time workers.

Data Source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

The rates published by BLS are the number of MSD cases per 10,000 full-time workers. The rates presented here, which are MSD cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 7.B
Work-related Musculoskeletal Disorders Involving Days Away from Work
Michigan and United States, 1992-2009

Musculoskeletal Disorders of the Neck, Shoulder, and Upper Extremities				
Year	Michigan		United States	
	Number	Rate	Number	Rate
1992	8,739	323	188,053	246
1993	9,295	325	195,117	247
1994	10,663	364	193,563	240
1995	10,304	340	179,819	221
1996	8,348	270	165,451	196
1997	7,395	226	163,499	189
1998	6,739	206	154,874	175
1999	7,608	228	156,734	173
2000	6,760	209	160,156	174
2001	6,163	200	147,580	163
2002	5,360	180	135,236	154
2003	4,800	165	125,050	142
2004	3,970	135	117,270	132
2005	3,600	118	107,800	118
2006	2,890	96	102,150	110
2007	2,780	98	97,690	103
2008	2,740	98	90,600	95
2009	2,250	88	82,640	91

Rates are the number of cases per 100,000 full-time workers.

Data Source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

The rates published by BLS are the number of MSD cases per 10,000 full-time workers. The rates presented here, which are MSD cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 10.C
Deaths from or with asbestosis
ages 15 and older, Michigan and United States, 1990-2009

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	14	1.9	2.0	948	4.9	5.0
1991	15	2.1	2.1	946	4.8	4.9
1992	16	2.2	2.2	959	4.8	4.9
1993	16	2.2	2.2	999	5.0	5.1
1994	17	2.3	2.4	1,060	5.2	5.3
1995	23	3.1	3.2	1,169	5.7	5.8
1996	20	2.6	2.8	1,176	5.7	5.7
1997	23	3.0	3.0	1,171	5.6	5.7
1998	16	2.1	2.1	1,221	5.8	5.8
Change to ICD-10 Coding						
1999	30	3.9	4.0	1,265	5.9	5.9
2000	24	3.1	3.2	1,493	6.8	6.9
2001	32	4.1	4.2	1,454	6.5	6.6
2002	29	3.7	3.7	1,473	6.5	6.6
2003	35	4.4	4.5	1,471	6.4	6.4
2004	31	3.9	3.9	1,470	6.3	6.3
2005	38	4.7	4.6	1,423	6.1	6.0
2006	36	4.5	4.4	1,344	5.7	5.6
2007	39	4.8	4.8	1,401	5.8	5.7
2008	34	4.2	4.1	1,346	5.5	5.4
2009	39	4.8	4.6	1,262	5.1	5.0

Rates are the number of deaths per million residents.

1. Total may not be equivalent to the sum of the subcategories as deaths can involve more than one form of pneumoconiosis.

* Reliable rate could not be calculated.

ICD-9 code for 1990-1998 deaths: 501

ICD-10 code for 1999-2009 deaths: J61

TABLE 10.D
Deaths from or with silicosis
ages 15 and older, Michigan and United States, 1990-2009

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	12	1.7	1.7	308	1.6	1.7
1991	7	1.0	1.1	314	1.6	1.7
1992	14	1.9	2.0	255	1.3	1.3
1993	15	2.0	2.2	276	1.4	1.4
1994	7	0.9	1.0	236	1.2	1.2
1995	12	1.6	1.7	242	1.2	1.2
1996	16	2.1	2.3	213	1.0	1.1
1997	<5	*	*	198	0.9	1.0
1998	9	1.2	1.2	178	0.8	0.9
Change to ICD-10 Coding						
1999	5	*	*	187	0.9	0.9
2000	8	1.0	1.1	152	0.7	0.7
2001	<5	*	*	164	0.7	0.7
2002	<5	*	*	148	0.6	0.7
2003	<5	*	*	179	0.8	0.8
2004	9	1.1	1.1	166	0.7	0.7
2005	7	0.9	0.9	161	0.7	0.7
2006	6	0.7	0.7	126	0.5	0.5
2007	0	-	-	123	0.5	0.5
2008	<5	*	*	148	0.6	0.6
2009	8	1.0	0.9	121	0.5	0.5

Rates are the number of deaths per million residents.

1. Total may not be equivalent to the sum of the subcategories as deaths can involve more than one form of pneumoconiosis.

* Reliable rate could not be calculated.

ICD-9 code for 1990-1998 deaths: 502

ICD-10 code for 1999-2009 deaths: J62

TABLE 10.E
Deaths from or with other and unspecified pneumoconiosis
ages 15 and older, Michigan and United States, 1990-2009

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	10	1.4	1.5	428	2.2	2.3
1991	<5	*	*	333	1.7	1.8
1992	7	0.9	0.9	288	1.5	1.5
1993	7	0.9	1.0	375	1.9	1.9
1994	<5	*	*	401	2.0	2.1
1995	<5	*	*	367	1.8	1.9
1996	5	*	*	358	1.7	1.8
1997	<5	*	*	297	1.4	1.5
1998	5	*	*	335	1.6	1.6
Change to ICD-10 Coding						
1999	6	0.8	0.8	325	1.5	1.5
2000	0	-	-	307	1.4	1.4
2001	<5	*	*	277	1.2	1.3
2002	6	0.8	0.7	264	1.1	1.1
2003	<5	*	*	241	1.1	1.1
2004	<5	*	*	224	1.0	1.0
2005	<5	*	*	227	1.0	0.9
2006	<5	*	*	220	0.9	0.9
2007	<5	*	*	170	0.7	0.7
2008	<5	*	*	223	0.9	0.9
2009	<5	*	*	163	0.7	0.6

Rates are the number of deaths per million residents.

1. Total may not be equivalent to the sum of the subcategories as deaths can involve more than one form of pneumoconiosis.

* Reliable rate could not be calculated.

ICD-9 code range for 1990-1998 deaths: 503-505

ICD-10 code range for 1999-2009 deaths: J63-J66

TABLE 11
 Number and rate of work-related pesticide-associated poisoning reported to poison control centers, ages 16 and older, Michigan and U.S., 2000-2009

Year	Michigan		United States	
	Number	Rate	Number	Rate
2000	74	1.5	2,827	2.1
2001	71	1.4	2,492	1.8
2002	59	1.3	2,528	1.8
2003	104	2.2	2,503	1.8
2004	77	1.6	2,476	1.8
2005	77	1.6	2,593	1.8
2006	72	1.5	2,560	1.8
2007	70	1.5	2,458	1.7
2008	66	1.5	2,171	1.5
2009	48	1.1	2,040	1.5

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases: American Association of Poison Control Centers. Employment statistics used to calculate rates: Geographic Profile of Employment and Unemployment.

TABLE 12
Incidence of malignant mesothelioma,
ages 15 and older, Michigan and U.S. residents, 1990-2009

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	81	11.2	12.2	NA	NA	NA
1991	69	9.4	9.9	NA	NA	NA
1992	82	11.1	11.7	NA	NA	14.7
1993	115	15.5	16.2	NA	NA	13.1
1994	95	12.7	13.5	NA	NA	13.9
1995	113	15.0	15.4	NA	NA	13.9
1996	92	12.1	12.3	NA	NA	13.9
1997	102	13.3	13.6	NA	NA	12.9
1998	96	12.5	12.8	NA	NA	13.3
1999	113	14.6	14.9	NA	NA	13.5
2000	138	17.7	18.0	NA	NA	13.4
2001	113	14.6	14.4	NA	NA	12.7
2002	123	15.5	15.7	NA	NA	12.2
2003	120	15.0	15.0	NA	NA	13.1
2004	114	14.2	14.1	2,759	11.9	13.8
2005	117	14.5	14.3	2,691	11.5	14.0
2006	118	14.6	14.5	2,637	11.1	12.8
2007	113	14.0	13.5	2,872	11.9	12.6
2008	110	13.7	13.1	3,003	12.3	12.5
2009	114	14.2	13.4	NA	NA	NA

NA – Not available

Rates are the number of cases per million residents.

Data sources: Number of Michigan mesothelioma cases: Michigan Cancer Registry. Number of residents used to calculate Michigan rates: Population Division, United States Census Bureau. National rates for 1992-2003 are estimates provided by the National Cancer Institute using the Surveillance, Epidemiology and End Results (SEER) program. National figures for 2004-2008 are from the North American Association of Central Cancer Registries (NAACCR).

TABLE 13.A
Prevalence of elevated blood lead levels
Michigan residents aged 16 and older, 1998-2009

Year	Measure (µg/dL)					
	≥10		≥25		≥40	
	Number	Rate	Number	Rate	Number	Rate
1998	NA	NA	298	6.2	72	1.5
1999	NA	NA	272	5.5	47	1.0
2000	NA	NA	238	4.7	48	1.0
2001	NA	NA	207	4.2	36	0.7
2002	NA	NA	194	4.1	31	0.7
2003	NA	NA	163	3.5	24	0.5
2004	NA	NA	151	3.2	23	0.5
2005	NA	NA	130	2.7	31	0.6
2006	724	15.3	108	2.3	22	0.5
2007	756	16.2	130	2.8	25	0.5
2008	675	14.9	127	2.8	22	0.5
2009	599	14.1	102	2.4	18	0.4

TABLE 13.B
Incidence of elevated blood lead levels
Michigan residents aged 16 and older, 1998-2009

Year	Measure (µg/dL)					
	≥10		≥25		≥40	
	Number	Rate	Number	Rate	Number	Rate
1998	NA	NA	--- ¹	--- ¹	--- ¹	--- ¹
1999	NA	NA	152	3.1	33	0.7
2000	NA	NA	140	2.8	44	0.9
2001	NA	NA	118	2.4	29	0.6
2002	NA	NA	125	2.7	25	0.5
2003	NA	NA	98	2.1	21	0.4
2004	NA	NA	103	2.2	22	0.5
2005	NA	NA	93	1.9	25	0.5
2006	457	9.7	71	1.5	15	0.3
2007	462	9.9	98	2.1	22	0.5
2008	384	8.5	93	2.1	18	0.4
2009	347	8.2	63	1.5	15	0.4

NA – Not available.

1. Incidence cannot be calculated for 1998. The regulation for laboratories to report BLLs to MDCH took effect in October, 1997, thus the prevalence for 1997 is incomplete. The calculation of incidence is based on prevalence for the prior year.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: Michigan Adult Blood Lead Epidemiology and Surveillance (ABLES) program. Employment estimates used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

TABLE 13.C
Prevalence of elevated blood lead levels
United States residents aged 16 and older, 1994-2008
(number of states reporting each year in parentheses)

Year	Measure ($\mu\text{g/dL}$)					
	≥ 10		≥ 25		≥ 40	
	Number	Rate	Number	Rate	Number	Rate
1994 (17)	NA	NA	9,225	14.0	2,119 ¹	3.5
1995 (18)	NA	NA	10,260	14.9	2,024 ²	3.2
1996 (20)	NA	NA	11,607	15.0	2,643	3.4
1997 (24)	NA	NA	12,614	14.8	2,668	3.1
1998 (24)	NA	NA	10,459	12.1	2,071	2.4
1999 (25)	NA	NA	10,310	11.6	1,933	2.2
2000 (25)	NA	NA	11,077	12.3	2,125	2.4
2001 (23)	NA	NA	9,730	11.1	1,835	2.1
2002 (35)	NA	NA	10,676	9.2	1,860	1.6
2003 (37)	NA	NA	9,884	8.2	1,649	1.4
2004 (37)	NA	NA	9,170	7.5	1,425	1.2
2005 (37)	NA	NA	8,902	7.2	1,498	1.2
2006 (38)	NA	NA	9,555	7.4	1,463	1.1
2007 (37) ³	NA	29.4	9,898	7.6	1,618	1.2
2008 (38)	NA	26.5	9,325	7.1	1,486	1.1

1. Sixteen (16) states reported prevalence of ≥ 40 ug/dl in 1994.
 2. Seventeen (17) states reported prevalence of ≥ 40 ug/dl in 1995.
 3. Twenty-two (22) states reported prevalence of ≥ 10 ug/dl in 2007.
- NA – Not available.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: national Adult Blood Lead Epidemiology Surveillance (ABLES) program. Employment estimates used to calculate rates: Bureau of Labor Statistics' Current Population Survey.

TABLE 13.D
Incidence of elevated blood lead levels
United States residents aged 16 and older, 1994-2008
(number of states reporting each year in parentheses)

Year	Measure (µg/dL)					
	≥10		≥25		≥40	
	Number	Rate	Number	Rate	Number	Rate
1994 (16)	NA	NA	4,356	6.8	799 ¹	1.4
1995 (16)	NA	NA	4,579	7.1	657 ¹	1.1
1996 (19)	NA	NA	5,716	7.6	1,235	1.6
1997 (24)	NA	NA	5,313	6.2	1,212	1.4
1998 (24)	NA	NA	4,284	4.9	907	1.0
1999 (25)	NA	NA	4,237	4.8	791	0.9
2000 (24)	NA	NA	4,852	5.4	930	1.0
2001 (20)	NA	NA	2,867	3.7	674	0.9
2002 (35)	NA	NA	6,015	5.2	901	0.8
2003 (37)	NA	NA	6,143	5.1	902	0.8
2004 (37)	NA	NA	5,671	4.7	849	0.7
2005 (37)	NA	NA	5,197	4.2	866	0.7
2006 (38)	NA	NA	5,666	4.4	859	0.7
2007 (37)	NA	NA	4,906	3.8	808	0.6
2008 (38)	NA	NA	4,470	3.4	693	0.5

1. Fifteen (15) states reported incidence of ≥ 40 ug/dl in 1994, 1995.
NA – Not available.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: national Adult Blood Lead Epidemiology Surveillance (ABLES) program. Employment estimates used to calculate rates: Bureau of Labor Statistics' Current Population Survey.

Technical Note: Counts represent residents and non-residents of reporting states. The denominators for calculating rates include only the resident workers of reporting states.

APPENDIX B

Description of Data Sources

The following sources were used to generate the thirteen occupational health indicators and the employment demographics for Michigan and the U.S. The first nine sources provided data for counts and the numerators for rate calculations. The last six were used to quantify the appropriate population at risk (i.e., denominators) for the calculation of rates and provided data for employment demographics.

Death Certificates

In Michigan, funeral directors, attending physicians, and medical examiners are responsible for the personal and medical information recorded on death certificates. Local registrars assure that all deaths in their jurisdictions are registered and that required information is documented before sending certificates to the Division for Vital Records and Health Statistics at the Michigan Department of Community Health (MDCH). State registrars number and file the death certificates and forward certificates of nonresidents to the appropriate state. All states send death certificate data to the National Vital Statistics System, managed by the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics.

The cause-of-death section on the certificate, which is similar in all states, contains the immediate, contributing and underlying causes of death. Since 1999, these causes have been coded according to the International Classification of Diseases, tenth revision (ICD-10)³⁶ format. For injury deaths, death certificates include a query about whether the incident occurred at work.

Michigan Cancer Registry

Data on cancer incidence and mortality are maintained in a registry at the Division for Vital Records and Health Statistics at the MDCH. Sources of incidence data include hospitals, laboratories, health clinics, dentists, physicians, nursing homes, and hospice. The registry is routinely linked to death certificate data to maintain the vital status of patients and augment the registry with demographic and other information from the death certificate. The registry was formed in 1985 under the authority of Act 82 of 1984 which established cancer as a reportable disease. Standards for the operation of cancer registries (e.g., data definitions, data transmission methodologies, and quality assurance) have been developed by the North American Association of Central Cancer Registries (NAACCR). Diagnoses are coded according to the International Classification of Diseases for Oncology (ICD-O).³⁷

Surveillance, Epidemiology and End Results (SEER)

National mesothelioma incidence estimates in this report for 1992-2003 were provided by the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute (NCI). SEER began collecting data on cancer cases in 1973 from five states and two metropolitan areas. As of 2003, the Program was collecting cancer incidence and survival data from 14 population-based cancer registries and three supplemental registries covering 26% of the U.S. population. Data routinely collected include patient demographics, primary tumor site, morphology, stage at diagnosis, first course of treatment and follow-up for vital status. Quality control is an integral part of the SEER program. Every year, studies are conducted to evaluate the quality and completeness of reported data. NCI generates data on cancer incidence at the county, state and national levels using statistical modeling of county-level demographic and lifestyle characteristics and data from SEER. This is an improvement over previous incidence estimates which were based on the assumption that every state's incidence/mortality ratio was equivalent.³⁸

North American Association of Central Cancer Registries (NAACCR)

Established in 1987, NAACCR is a collaborative umbrella organization for cancer registries, governmental agencies, professional associations, and private groups in North America interested in enhancing the quality and use of cancer registry data. All central cancer registries in the United States and Canada are members. NAACCR develops and promotes uniform data standards for cancer registration; provides education and training; certifies population-based registries; aggregates and publishes data from central cancer registries; and promotes the use of cancer surveillance data and systems for cancer control and epidemiologic research. One of NAACCR's first goals was to achieve consensus on cancer registration standards among the many standard-setting organizations in the United States and Canada, in order to facilitate compilation and comparison of information across different registries. Today, nearly all registries in North America have adopted the NAACCR consensus standards. NAACCR updates these standards annually to meet the changing needs of the registry community. Every year, NAACCR issues a call for data from its registry members. These data are evaluated for accuracy and compiled into analytic files to produce an annual statistical monograph *Cancer Incidence in North America (CINA)*. CINA+ Online is an online query system of cancer incidence data for the previous five years from selected member registries.

Hospital Discharge Data

Patient demographics, diagnoses, and billing information are contained within hospital medical records. Upon patient discharge from a hospital, these data are computerized using standard formats. Diagnoses are coded according to the International Classification of Diseases system, currently ICD-9-CM.³⁹ In Michigan, every acute care hospital voluntarily submits data to the Michigan Health and Hospital Association. This aggregated dataset is the Michigan Inpatient Database (MIDB).

National hospitalization data were obtained through the National Center for Health Statistics National Hospital Discharge Survey (NHDS). The NHDS annually collects data from a sample of approximately 270,000 inpatient records from 500 short-stay, non-federal hospitals. The NHDS uses a three-stage probability design. The first stage of sampling consists of primary sampling units (PSUs) comprised generally of counties or groups of counties. In the second stage of sampling, a systematic random sample of hospitals from within sample PSUs is selected. In the third stage, a sample of inpatient records is selected within sample hospitals.

Hospital discharge data have several limitations for providing information on occupational health. There is no specific query as to the work-relatedness of any illness or injury. A useful proxy for work-related injury is workers' compensation insurance as the payer. Workers' compensation as the payer source is much less sensitive in identifying illnesses. Illnesses are much harder to associate with a work condition due to the non-specificity of many occupational diseases or the long latency between exposure and onset of overt disease. Personal identifiers are not available, thus repeat hospitalizations of the same individual cannot be identified. Federal hospitals (military and veterans' hospitals) are not included in the MIDB or the NHDS.

Workers' Compensation

Workers' compensation is a no-fault insurance system designed to provide compensation to workers who sustain work-related injuries or illnesses while limiting the legal liability of employers. In Michigan, nearly all private and non-federal public employers are required to have workers' compensation coverage for their employees per the Workers' Disability Compensation Act of 1969. Employers are allowed to self-insure, group self-insure, insure through private

carriers, or insure through a state fund. In general, a worker who sustains a work-related injury or illness reports this to the employer who then sends the worker to a healthcare professional and reports the incident to the company's insurance carrier. If an incident results in death, certain injuries (e.g., amputation), or the employee missing more than seven consecutive days of work, the employer submits a Form 100 to the Bureau of Workers' and Unemployment Compensation (BWUC) at the Michigan Department of Licensing and Regulatory Affairs. Data on Form 100s, which contain information on employee demographics and the injury/illness, are entered into an administrative database.

Although all states have workers' compensation systems, there are significant state-to-state differences in coverage, procedures for filing claims, and data that are collected. There are no national injury/illness data from workers' compensation claims.

Survey of Occupational Injuries and Illnesses

The Survey of Occupational Injuries and Illnesses (Annual Survey), conducted by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor, provides annual estimates of the numbers and incidence rates of work-related injuries and illnesses among workers nationwide. Public sector workers such as firefighters and police were excluded from national estimates prior to 2008. Information is collected through an annual survey mailed to a stratified random sample of establishments (in Michigan, the survey is conducted by the Michigan Occupational Safety and Health Administration [MIOSHA] within the Michigan Department of Licensing and Regulatory Affairs). Employers respond to the survey using information on work-related injuries and illnesses that is recorded as required under the Occupational Safety and Health Administration (OSHA) record-keeping standard 29 CFR 1904. Recordable injuries and illnesses include those that result in loss of consciousness, one or more days away from work to recuperate, restricted work activity, transfer to another job, or medical treatment beyond simple first aid. More detailed information on worker demographics and the nature and circumstances of the injuries and illnesses is collected for cases resulting in days away from work. The Annual Survey also collects data on the average number of workers employed and the total hours worked at each establishment, information that allows the BLS to calculate rates.

Most states, including Michigan, participate in the federal-state survey program. For these states, the survey data generate state as well as national estimates. Since 2008, public sector employers have been included in the survey. (Since trend analyses in this report span years prior to and after 2008, public sector workers were excluded from both Michigan and national estimates so rates would be comparable.) Because the Annual Survey is based on a sample – and not a census – of all establishments, its findings are estimates with corresponding sampling errors. The BLS adheres to strict publication guidelines based on the reliability of the estimates; numbers and rates are not published or released by the BLS if the estimates do not meet these guidelines.

The self-employed, farms with fewer than 11 employees, private households, federal agencies, and the military are not covered in the Annual Survey. It is well recognized that the survey undercounts work-related illnesses, especially long-latency illnesses that may not appear until years after individuals have left their place of employment. There is also evidence that work-related injuries are underreported.^{5,6}

Census of Fatal Occupational Injuries

The Census of Fatal Occupational Injuries (CFOI), conducted by the BLS in the U.S. Department of Labor, is a federal-state cooperative program that compiles an annual census of

fatal occupational injuries at both the state and national levels. In Michigan, data are collected by the Michigan Occupational Safety and Health Administration (MIOSHA) within the Michigan Department of Licensing and Regulatory Affairs. For a death to be counted, the decedent must have been working for pay, compensation or profit at the time of the event, engaged in a legal work activity, or present at the site of the incident as a requirement of his or her job. The census includes unintentional injuries (e.g., falls, electrocutions, motor vehicle crashes) and intentional injuries (homicide and suicide). Deaths due to occupational illnesses are excluded. CFOI uses multiple data sources to identify and document work-related injury deaths. These sources include, among others, death certificates, workers' compensation records, reports to regulatory agencies, medical examiner and police reports, as well as reports in the news media. Multiple sources are used because studies have found that no single source captures all deaths. In addition, two or more sources are required to ensure an accurate count by independently substantiating that incidents were work-related. Due to this methodology, CFOI counts are considered a complete or near complete ascertainment of work-related injury deaths.

Poison Control Centers

Poison control centers (PCCs) are available nationwide to provide assistance 24 hours a day to callers with concerns about actual or potential exposure to substances. Calls originating from Michigan are handled by Children's Hospital of Michigan in Detroit (prior to its closure on June 30, 2009, the DeVos Children's Hospital in Grand Rapids served as a second Michigan PCC handling calls from 65 of the state's 83 counties). Most PCCs, including Michigan's, track calls and manage case information electronically using ToxiCall®. Centers representing 100% of the U.S. population submit data on a realtime basis to the American Association of Poison Control Centers (AAPCC).⁴⁰

PCCs categorize inquiries as human or animal exposures, or non-exposures and information-only. For nearly half of human exposure calls, PCCs follow up to provide further guidance, confirm compliance with recommendations, and gather outcome data.⁴⁰ The types of information gathered by PCCs include demographics, type of substance(s) involved, symptoms, intentionality of exposure, whether the exposure was work-related, location of exposure (e.g., workplace), and medical outcome. PCCs do not systematically collect information on industry and occupation. Centers that use ToxiCall® can generate nearly 100 standard reports or create ad hoc reports to meet more specific needs. A significant limitation of PCC data for occupational surveillance is that it is a passive system; that is, it relies on cases to be reported. To report a case, the poisoned individual or a health care worker has to know about the existence of a PCC, consider it a source of assistance for addressing a work-related illness, and know how to contact the PCC. Because of the passive surveillance system design, it is likely that PCC data underestimate the true extent of work-related chemical exposures.

Adult Blood Lead Epidemiology and Surveillance

The Adult Blood Lead Epidemiology and Surveillance (ABLES) system, a state-based program funded by CDC's National Institute for Occupational Safety and Health (NIOSH), commenced in 1987 in four states. As of 2009, 40 states, including Michigan, were participating in the system. Surveillance of elevated blood lead levels (BLLs) provides a method for identifying industries and occupations where workers are at high risk for exposure to lead. States participating in ABLES require that clinical laboratories report BLL results to a state agency. In Michigan, results are sent to MDCH which subsequently forwards reports for adults to the Michigan State University College of Human Medicine, Occupational and Environment Medicine Division. Laboratory reports include basic demographic information. States use unique

identifiers to differentiate between new and existing cases and to account for multiple reports for the same person. Most states follow up reports of elevated BLLs to determine the sources of lead exposure, including the name of the employer, and additional information about the exposed individual. The Occupational Safety and Health Administration (OSHA) requires that lead be measured clinically in workers exposed to airborne lead exceeding a certain level. Because of this requirement and because laboratories generally comply with the reporting requirement, ABLES programs are believed to identify a substantial portion of lead-exposed workers. However, they do not capture lead-exposed individuals whose employers are not in compliance with the biological monitoring requirements, or individuals tested by laboratories that are not compliant with the reporting requirement. Data from ABLES states are submitted to NIOSH, where they are aggregated. Analyses based on the aggregate data are published in CDC's Morbidity and Mortality Weekly Report (MMWR). The aggregated data from ABLES are not necessarily representative of the nation as there is less than 100% participation; states that participate were not selected based on representativeness.

Census

The U.S. Census Bureau takes the census of the entire nation in years ending in zero. Census data are used to distribute government funding, draw state legislative districts, identify populations in need of services, determine business locations, and for many other purposes. In Census 2000, a short form was sent to every household, and a long form with more detailed questions was sent to a sample of about one in six households. The short form ascertained basic demographics, while the long form sought information on social, economic, and financial characteristics of individuals, and physical characteristics of housing. The economic characteristics included labor force status, place of work, occupation, industry, work status, and income. Following Census 2000, there was debate about undercounting the population. Subsequently, the Census Bureau performed a coverage measurement survey. Based on survey results, the Bureau decided that no adjustments would be made.

The Population Division of the Census Bureau also provides population figures for non-census years. Postcensal estimates are computed after a decennial census using the components of population change: births, deaths, and migration. Intercensal estimates refer to population estimates for years between two censuses (e.g., 1991-1999). These estimates are based on data from the two censuses and the original set of postcensal estimates developed during that decade.

Current Population Survey

The Current Population Survey (CPS) is a monthly survey of about 60,000 households representing the civilian non-institutionalized population of the United States. It is conducted by the U.S. Census Bureau for the Bureau of Labor Statistics. The CPS ascertains demographics, employment status, weekly hours worked, and industry and occupation of each household member aged 15 years and older. The inquiry relates to activity or status during the calendar week that includes the 12th day of the month. One of the ways the BLS makes the survey data available is a data analysis program, "DataFerrett," that users can access via the Internet. The occupational and industrial classifications of CPS data for 1992 through 2002 were based on the coding systems used in the 1990 Census. Since then, the CPS has changed its coding systems for occupation and industry. More information can be found at www.census.gov. The CPS undercounts certain racial/ethnic workers who have no permanent address or are migratory in nature. Because CPS estimates are based on a survey rather than a complete census of the population, they are subject to sampling error.

Geographic Profile of Employment and Unemployment

Each year, the BLS produces annual average employment information for census regions, states and metropolitan areas in its “Geographic Profile of Employment and Unemployment” series. Data from the Current Population Survey (described above) are the basis for the information provided on the employed and unemployed by selected demographic and economic characteristics. Starting in 2002, all data for states and regions reflect Census 2000-based population controls (i.e., Census 2000 data were used to adjust the weights applied to sample respondents).

Employment and Earnings

The BLS produces a monthly report on national employment and earnings. This information is compiled from two sources, the Current Population Survey (CPS) and the Current Employment Statistics (CES) survey. The CPS data are described above. The CES survey data are gathered from a sample of employers and provide industry information on employment, average weekly hours, average hourly earnings and average weekly earnings. CPS-based data in the Employment and Earnings report were the source of the national information provided in the Employment Demographics section.

Local Area Unemployment Statistics

The Local Area Unemployment Statistics (LAUS) program is a Federal-State cooperative effort in which monthly estimates of total employment and unemployment are prepared for approximately 7,200 areas including each state. The concepts and definitions underlying LAUS data come from the CPS. State monthly model estimates are controlled in "real time" to sum to national monthly labor force estimates from the CPS. These models combine current and historical data from the CPS, the CES program, and State unemployment insurance (UI) systems.

National Academy of Social Insurance

The National Academy of Social Insurance (NASI) is a non-profit, non-partisan organization dedicated to the study of social insurance programs such as workers’ compensation, Medicare, and unemployment insurance. NASI produces an annual research report estimating the annual benefits, coverage, and costs associated with workers’ compensation systems at the state level. NASI estimates the number of workers covered by workers’ compensation insurance by utilizing state unemployment insurance data. These data are then adjusted for differences in workers’ compensation coverage laws with unemployment insurance coverage laws within a state.

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